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# Report On

FCC Part 2 and 22 Testing of the Sharp SH-011  
CDMA2000(US850MHz) Cellular Phone with Bluetooth

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Document 75911236 Report 03 Issue 1

November 2010





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COMMERCIAL-IN-CONFIDENCE

**REPORT ON**

FCC Part 2 and 22 Testing of the Sharp SH-011  
CDMA2000(US850MHz) Cellular Phone with Bluetooth

Document 75911236 Report 03 Issue 1

November 2010

**PREPARED FOR**

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**PREPARED BY**

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Senior Administrator

**APPROVED BY**

**M Jenkins**  
Authorised Signatory

**DATED**

16 November 2010

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**ENGINEERING STATEMENT**

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC CFR 47: Part 2 and 24. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

M Russell

S Bennett

G Lawler





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## **SECTION 1**

### **REPORT SUMMARY**

FCC Part 2 and 22 Testing of the Sharp SH-011  
CDMA2000(US850MHz) Cellular Phone with Bluetooth



## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of Sharp SH-011 CDMA2000(US850MHz) Cellular Phone with Bluetooth to the requirements of FCC CFR 47 Part 2 and 22.

Objective	To perform FCC Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Sharp Corporation, Communication Systems Group
Manufacturing Description	CDMA2000(US850MHz) Cellular Phone with Bluetooth
Model Number(s)	SH-011
Serial Number(s)	000902
Software Version	A9170
Hardware Version	PP1
Number of Samples Tested	1
Test Specification/Issue/Date	FCC CFR 47 Part 2: 2009 FCC CFR 47 Part 22: 2009
Incoming Release Date	Application Form 12 November 2010
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	8147 19 October 2010
Start of Test	01 November 2010
Finish of Test	02 November 2010
Name of Engineer(s)	M Russell S Bennett G Lawler
Related Document(s)	ANSI C63.4: 2003



**1.2 BRIEF SUMMARY OF RESULTS**

A brief summary of results for each configuration, in accordance with FCC CFR 47 Part 2 and 22 is shown below.

Configuration 1: Stand Alone							
Section	Spec Clause		Test Description	Mode	Mod State	Result	Base Standard
	Part 2	Part 22					
2.1	2.1051	22.905	Spurious Emissions at Band Edge	824.70 MHz	0	Pass	
				836.52 MHz		N/A	
				848.37 MHz	0	Pass	
2.2	-	22.913(a)	Effective Radiated Power	824.70 MHz	0	Pass	
				836.52 MHz	0	Pass	
				848.37 MHz	0	Pass	
2.3	2.1046	22.913(a)	Maximum Peak Output Power – Conducted	824.70 MHz	0	Pass	
				836.52 MHz	0	Pass	
				848.37 MHz	0	Pass	
2.4	-	22.917	Emission Limitations for Cellular Equipment	824.70 MHz	0	Pass	
				836.52 MHz	0	Pass	
				848.37 MHz	0	Pass	
2.5	2.1051	22.917(a)	Conducted Spurious Emissions	824.70 MHz	0	Pass	
				836.52 MHz	0	Pass	
				848.37 MHz	0	Pass	
2.6	2.1049(h)	22.917(b)	Occupied Bandwidth	824.70 MHz	0	Pass	
				836.52 MHz	0	Pass	
				848.37 MHz	0	Pass	
2.7	2.1047(d)	-	Modulation Characteristics	824.70 MHz		N/A	
				836.52 MHz	0	Pass	
				848.37 MHz		N/A	
2.8	2.1055	22.355	Frequency Stability Under Temperature Variations	824.70 MHz		N/A	
				836.52 MHz	0	Pass	
				848.37 MHz		N/A	
2.9	2.1055	22.355	Frequency Stability Under Voltage Variations	824.70 MHz		N/A	
				836.52 MHz	0	Pass	
				848.37 MHz		N/A	

N/A – Not Applicable



1.3 APPLICATION FORM

EQUIPMENT DESCRIPTION	
Model Name/Number	CDMA SH011
Part Number	N/A
Technical Description (Please provide a brief description of the intended use of the equipment)	CDMA2000 (US850MHz) Cellular Phone with Bluetooth

POWER SOURCE			
<input type="checkbox"/>	AC mains	State voltage	
	AC supply frequency	(Hz)	
	VAC		
	Max Current		
	Hz		
<input type="checkbox"/>	Single phase	<input type="checkbox"/>	Three phase
	And / Or		
<input type="checkbox"/>	External DC supply		
	Nominal voltage	V	Max Current A
	Extreme upper voltage	V	
	Extreme lower voltage	V	
	Battery		
<input type="checkbox"/>	Nickel Cadmium	<input type="checkbox"/>	Lead acid (Vehicle regulated)
<input type="checkbox"/>	Alkaline	<input type="checkbox"/>	Leclanche
<input checked="" type="checkbox"/>	Lithium	<input type="checkbox"/>	Other Details :
4.0	Volts nominal.		
End point voltage as quoted by equipment manufacturer		3.7	V

FREQUENCY INFORMATION					
Frequency Range	824.7 to 848.31	MHz			
Channel Spacing (where applicable)	30kHz				
Test Frequencies*	Bottom	814.7	MHz	Channel Number (if applicable)	1013
	Middle	836.52	MHz	Channel Number (if applicable)	384
	Top	848.31	MHz	Channel Number (if applicable)	777
If alternate test modes are available resulting in different test frequencies please specify which mode is applicable:					
<b>POWER CHARACTERISTICS</b>					
Maximum TX power	25dBm	W			
Minimum TX power	-50dBm	W (if variable)			
Is transmitter intended for :					
Continuous duty				<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Intermittent duty				<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
If intermittent state DUTY CYCLE					
Transmitter ON		seconds			
Transmitter OFF		seconds			



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ANTENNA CHARACTERISTICS			
<input type="checkbox"/>	Antenna connector	State impedance	Ohm
<input type="checkbox"/>	Temporary antenna connector	State impedance	Ohm
<input checked="" type="checkbox"/>	Integral antenna	Gain	3.0 dBi

MODULATION CHARACTERISTICS			
<input type="checkbox"/>	Amplitude	<input type="checkbox"/>	Frequency
<input type="checkbox"/>	Phase	<input checked="" type="checkbox"/>	Other (please provide details): BPSK,HPSK,QPSK
Can the transmitter operate un-modulated?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

CLASS OF EMISSION USED	
ITU designation or Class of Emission:	
1	1M28F9W
(if applicable) 2	
(if applicable) 3	
If more than three classes of emission, list separately:	

EXTREME CONDITIONS					
Extreme test voltages (Max)	4.0	V	Extreme test voltages (Min)	3.7	V
Nominal DC Voltage	4.0	V	DC Maximum Current	600m	A
Maximum temperature	60	°C	Minimum temperature	-20	°C

I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplied is correct and complete.

Signature:     *T. Taki*     Name: Tetsuya Taki  
 Position held: Manager Date: 12<sup>th</sup>, November 2010



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## 1.4 PRODUCT INFORMATION

### 1.4.1 Technical Description

The Equipment Under Test (EUT) was a Sharp SH-011 CDMA2000(US850MHz) Cellular Phone with Bluetooth. A full technical description can be found in the manufacturer's documentation.

### 1.4.2 Test Configuration

#### Configuration 1: Stand Alone

The EUT was configured in accordance with FCC CFR 47 Part 2 and 22.

### 1.4.3 Modes of Operation

Modes of operation of each EUT during testing were as follows:

Mode 1 – 824.70 MHz

Mode 2 – 836.52 MHz

Mode 3 – 848.37 MHz

Information on the specific test modes utilised are detailed in the test procedure for each individual test.



Product Service

## **1.5 TEST CONDITIONS**

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure or test laboratories as appropriate.

The EUT was powered from either a DC Bench Power Supply or a battery, as detailed in each test result section.

FCC Accreditation  
90987 Octagon House, Fareham Test Laboratory

## **1.6 DEVIATIONS FROM THE STANDARD**

No deviations from the applicable test standards or test plan were made during testing.

## **1.7 MODIFICATION RECORD**

No modifications were made to the EUT during testing.



Product Service

## **SECTION 2**

### **TEST DETAILS**

FCC Part 2 and 22 Testing of the Sharp SH-011  
CDMA2000(US850MHz) Cellular Phone with Bluetooth



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## 2.1 SPURIOUS EMISSIONS AT BAND EDGE

### 2.1.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051  
FCC CFR 47 Part 22, Clause 22.905

### 2.1.2 Equipment Under Test

SH-011, S/N: 000902

### 2.1.3 Date of Test and Modification State

03 November 2010 - Modification State 0

### 2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.1.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 22.

In accordance with 22.917(e), any emissions outside of the block edges shall be attenuated by at least  $43 + 10 \log (P)$ . The measurements are shown to  $\pm 1$  MHz from the block edges. The plots shown under the Spurious Emissions sections covers the required range of 9 kHz to 10 GHz.

The reference power and path losses of all channels used for testing in each frequency block were measured. Having entered the reference level offset, a resolution bandwidth of 10 kHz was chosen. The limit line was set to  $(-13 - 10 \log 14.5/10)$  dBm to allow for a resolution bandwidth less than one percent of the emission bandwidth, (10 kHz as oppose to 14.5 kHz). The EUT was operated at maximum power with 64-Ray Orthogonal and BPSK modulation schemes.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1  
- Mode 3

### 2.1.6 Environmental Conditions

	03 November 2010
Ambient Temperature	24.7°C
Relative Humidity	45.6%



Product Service

**2.1.7 Test Results**

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 22 for Spurious Emissions at Band Edge.

The test results are shown below.

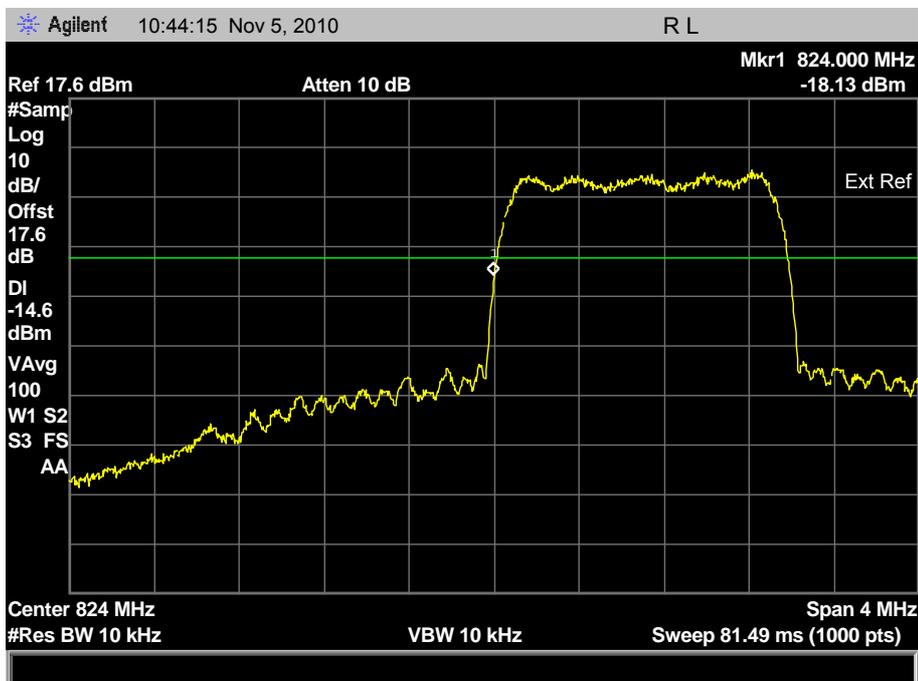
Configuration 1 – Modes 1 and 3

4.0 V DC Supply

Frequency Block (MHz)	Mode	Lower Block Edge Test Channels/Frequencies	Upper Block Edge Test Channels/Frequencies
A : (824.0 – 835.0)	64-Ray Orthogonal	Channel : 1013 Frequency : 824.70MHz	N/A
B : (846.5 – 849.0)	64-Ray Orthogonal	N/A	Channel : 777 Frequency : 848.31MHz
A : (824.0 – 835.0)	BPSK	Channel : 1013 Frequency : 824.70MHz	N/A
B : (846.5 – 849.0)	BPSK	N/A	Channel : 777 Frequency : 848.31MHz

64-Ray Orthogonal

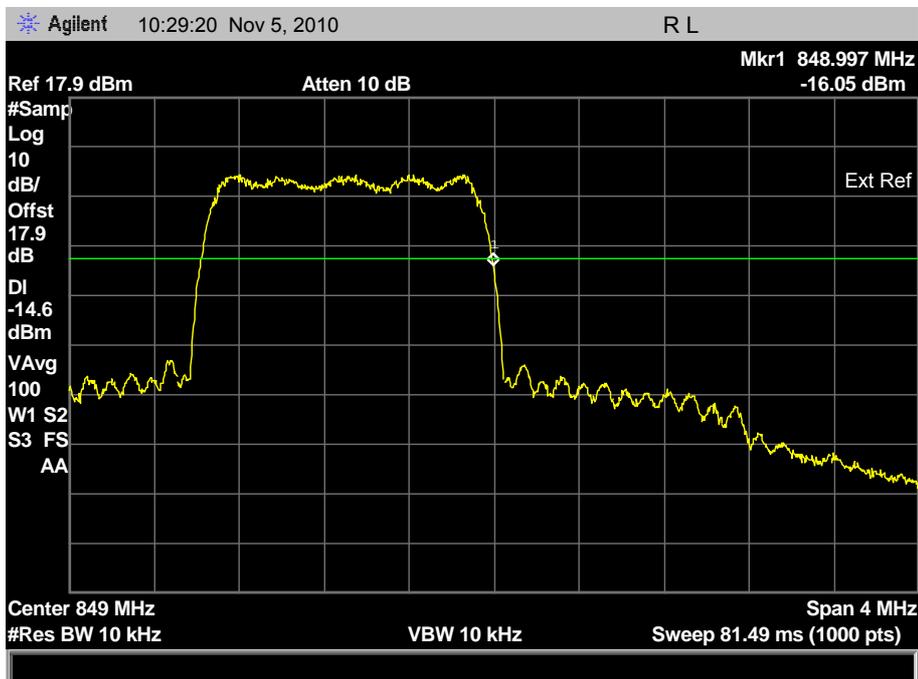
Frequency Block A





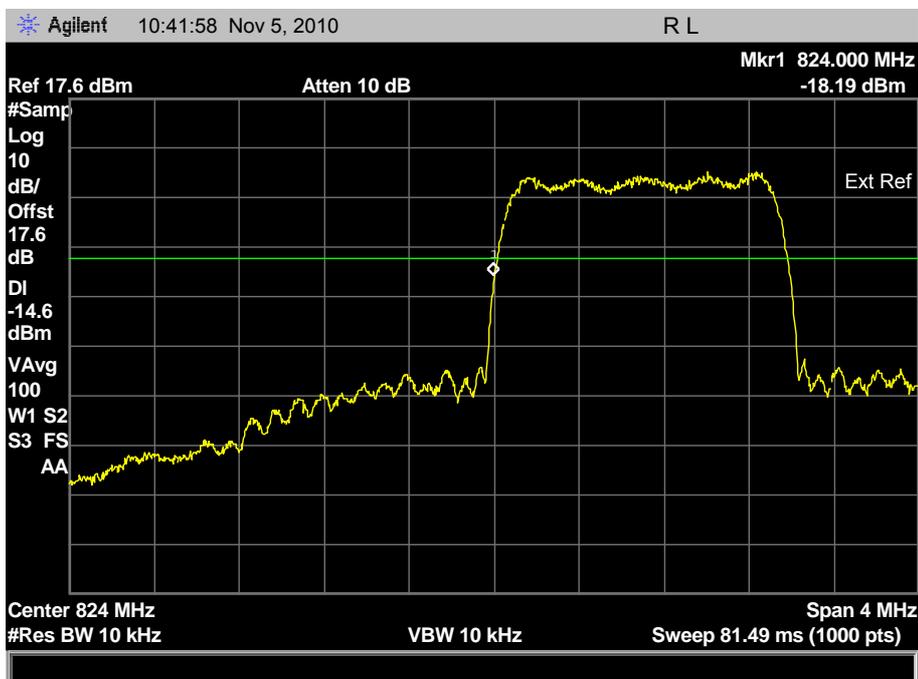
Product Service

Frequency Block B



BPSK

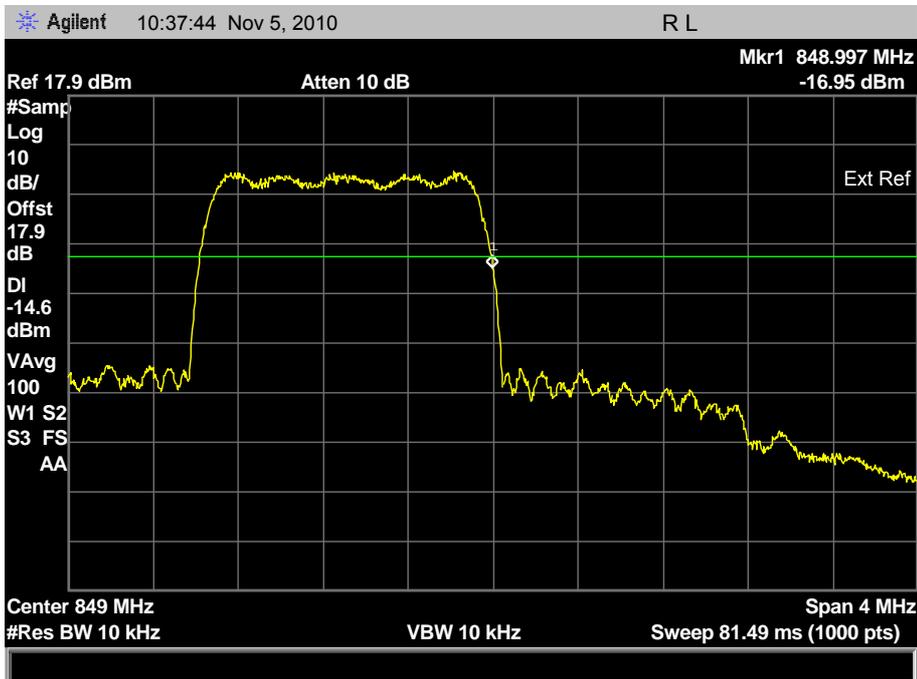
Frequency Block A





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Frequency Block B



Limit Clause

-13 dBm at block edge.



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## 2.2 EFFECTIVE RADIATED POWER

### 2.2.1 Specification Reference

FCC CFR 47 Part 22, Clause 22.913(a)

### 2.2.2 Equipment Under Test

SH-011, S/N: 000902

### 2.2.3 Date of Test and Modification State

02 November 2010 - Modification State 0

### 2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.2.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 22.

Measurements of the fundamental from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The fundamental frequency was maximised by adjusting the antenna height, antenna polarisation and turntable azimuth. A peak detector was used with the trace set to max hold. The maximum result was recorded.

The EUT was then removed from the chamber and replaced with a substitution antenna. Using a signal generator the level was adjusted to achieve the same value on the measuring instrument as previously recorded with the EUT. The final result (ERP) was determined by a calculation using the signal generator level, antenna gain and cable loss.

The measurements were performed at a 3m distance unless otherwise stated.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1  
                          - Mode 2  
                          - Mode 3

### 2.2.6 Environmental Conditions

	02 November 2010
Ambient Temperature	24.8°C
Relative Humidity	31.0%



Product Service

**2.2.7 Test Results**

For the period of test the EUT met the requirements of FCC CFR 47 Part 22 for Effective Isotropic Radiated Power.

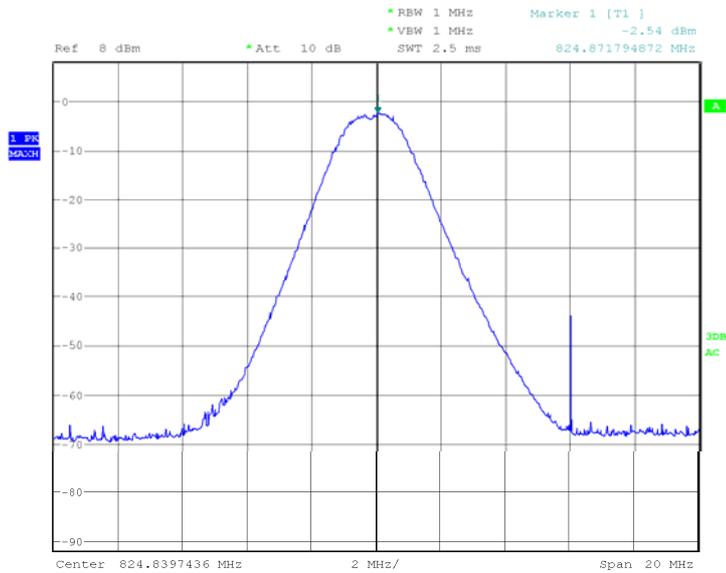
The test results are shown below.

Powered by internal battery

Configuration 1 - Mode 1

64-Ray Orthogonal

Frequency	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
824.70	26.0	38.45	0.398	7.0

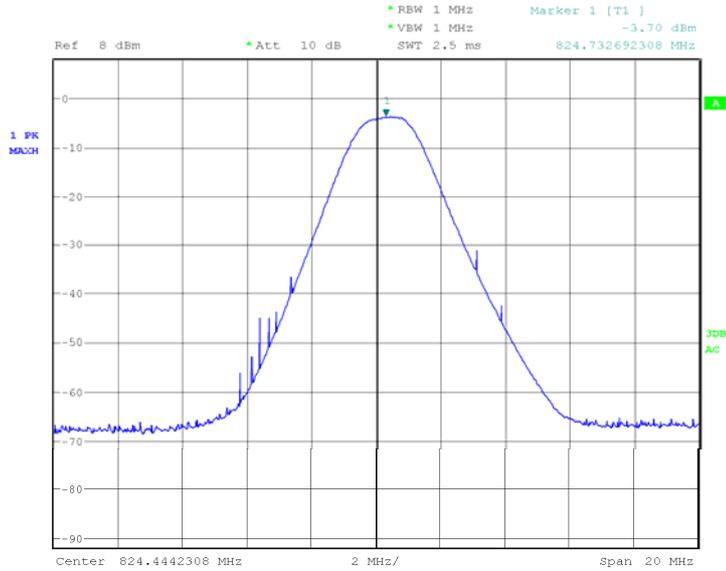


Date: 2.NOV.2010 21:17:52



**BPSK**

Frequency	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
824.70	24.9	38.45	0.309	7.0



Date: 2.NOV.2010 22:33:07

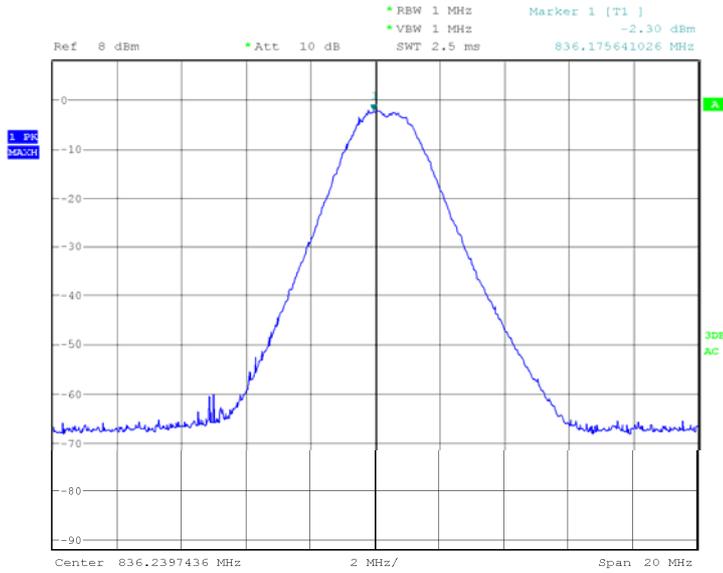


Product Service

Configuration 1 - Mode 2

64-Ray Orthogonal

Frequency	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
836.52	26.7	38.45	0.468	7.0



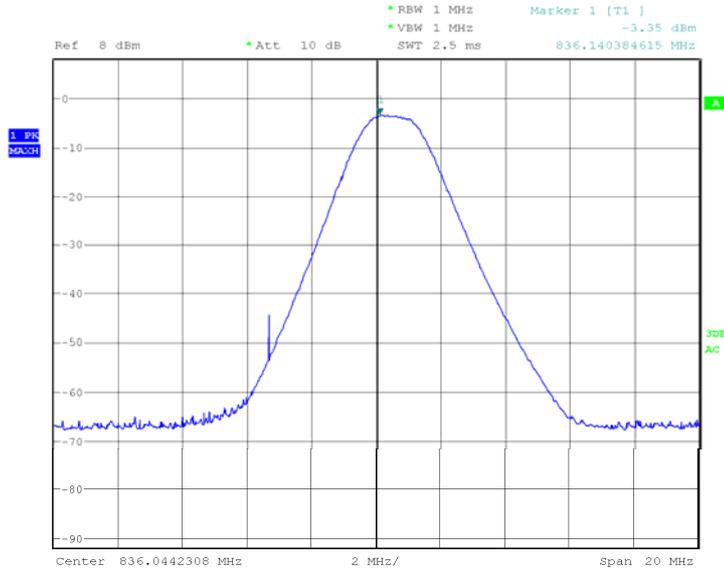
Date: 2.NOV.2010 21:49:30



Product Service

**BPSK**

Frequency	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
836.52	25.7	38.45	0.372	7.0



Date: 2.NOV.2010 22:29:30

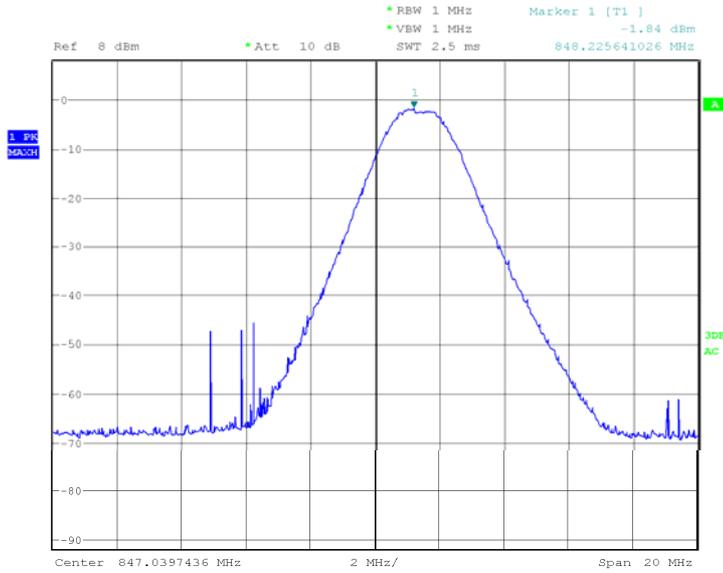


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Configuration 1 - Mode 3

64-Ray Orthogonal

Frequency	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
848.37	27.4	38.45	0.550	7.0



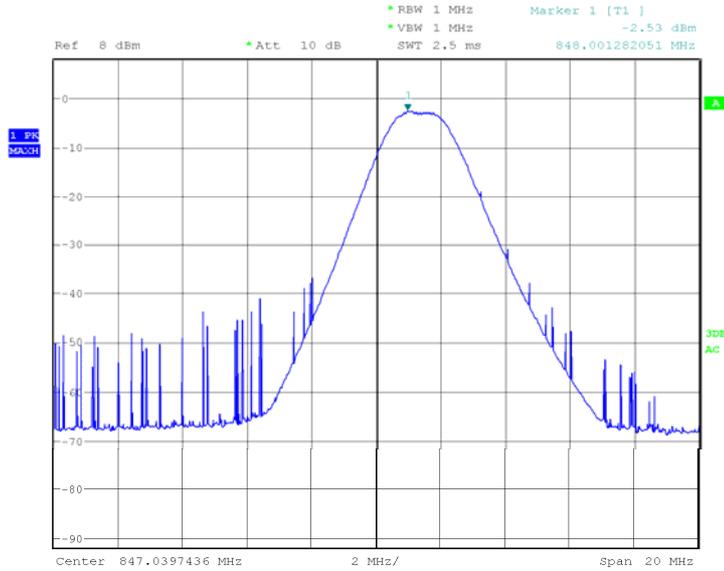
Date: 2.NOV.2010 22:06:41



Product Service

**BPSK**

Frequency	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
848.37	26.5	38.45	0.447	7.0



Date: 2.NOV.2010 22:16:15

**Limit Clause**

Mobile – 7 W, Base Stations – 500 W



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## **2.3 MAXIMUM PEAK OUTPUT POWER - CONDUCTED**

### **2.3.1 Specification Reference**

FCC CFR 47 Part 22, Clause 2.1046  
FCC CFR 47 Part 22, Clause 22.913(a)

### **2.3.2 Equipment Under Test**

SH-011, S/N: 000902

### **2.3.3 Date of Test and Modification State**

02 November 2010 - Modification State 0

### **2.3.4 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.3.5 Test Method and Operating Modes**

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 22.

Using a peak power meter analyser and attenuator(s), the output power of the EUT was measured at the antenna terminals.

The EUT supports CDMA 2000 and was tested in 64-Ray Orthogonal and BPSK modulation schemes.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1  
                          - Mode 2  
                          - Mode 3

### **2.3.6 Environmental Conditions**

02 November 2010

Ambient Temperature 23.5°C

Relative Humidity 39.6%



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### 2.3.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 22 for Maximum Peak Output Power - Conducted.

The test results are shown below.

Configuration 1 - Modes 1, 2 and 3

4.0 V DC Supply

Frequency (MHz)	Mode	Result (dBm)		Result (W)	
		Peak	Average	Peak	Average
824.70	64-Ray Orthogonal	28.12	23.62	0.649	0.230
836.52	64-Ray Orthogonal	28.13	23.45	0.650	0.221
848.37	64-Ray Orthogonal	28.04	23.27	0.637	0.212
824.70	BPSK	26.48	23.78	0.445	0.239
836.52	BPSK	26.77	23.62	0.475	0.230
848.37	BPSK	26.74	23.50	0.472	0.224

#### Limit Clause

Mobile – 7 W

Base Stations – 500 W



Product Service

## **2.4 EMISSION LIMITATIONS FOR CELLULAR EQUIPMENT**

### **2.4.1 Specification Reference**

FCC CFR 47 Part 22, Clause 22.917

### **2.4.2 Equipment Under Test**

SH-011, S/N: 000902

### **2.4.3 Date of Test and Modification State**

07 November 2010 - Modification State 0

### **2.4.4 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.4.5 Test Method and Operating Modes**

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 22.

A preliminary profile of the Spurious Radiated Emissions was obtained up to the 10th harmonic by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Using the information from the preliminary profiling of the EUT, the list of emissions was then confirmed or updated under Alternative Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth.

The EUT was set to transmit on full power on 64-Ray Orthogonal and BPSK modulation schemes. The EUT was tested on bottom, middle and top channels at maximum power.

For any emissions found the EUT was then removed from the chamber and replaced with a substitution antenna. Using a signal generator the level was adjusted to achieve the same value on the measuring instrument as previously recorded with the EUT. The final result was determined by a calculation using the signal generator level, antenna gain and cable loss. The measurements were performed at a 3m distance unless otherwise stated.

The test was performed with the EUT in the following configurations and modes of operation:

- Configuration 1 - Mode 1
- Mode 2
- Mode 3



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#### 2.4.6 Environmental Conditions

07 November 2010

Ambient Temperature 24.0°C

Relative Humidity 27.0%

#### 2.4.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 22 for Emission Limitations for Cellular Equipment.

The test results are shown below.

Powered by internal battery

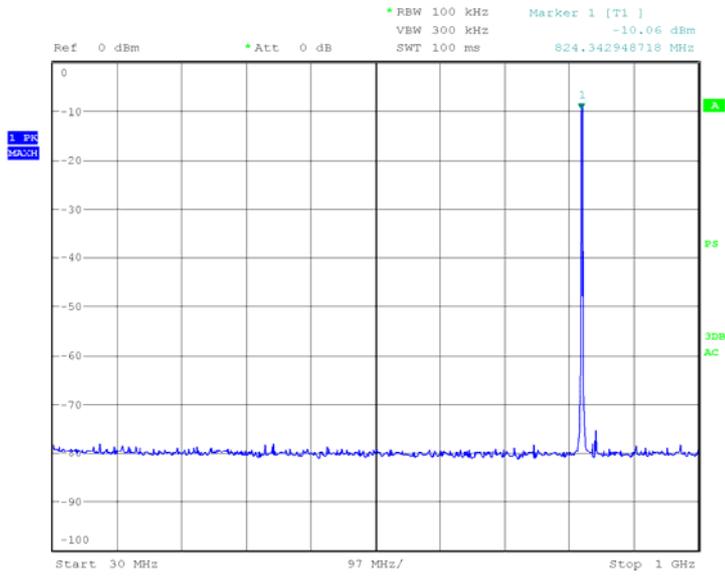
Configuration 1 - Mode 1

64-Ray Orthogonal

Frequency (MHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Peak Result (dBm)	ERP Limit (dBm)	Margin (dB)
1649	Horizontal	133	161	-41.3	-13	28.3
2474	Horizontal	100	37	-49.3	-13	36.3
3300	Horizontal	100	298	-47.9	-13	34.9
9896	Vertical	100	012	-38.4	-13	25.4

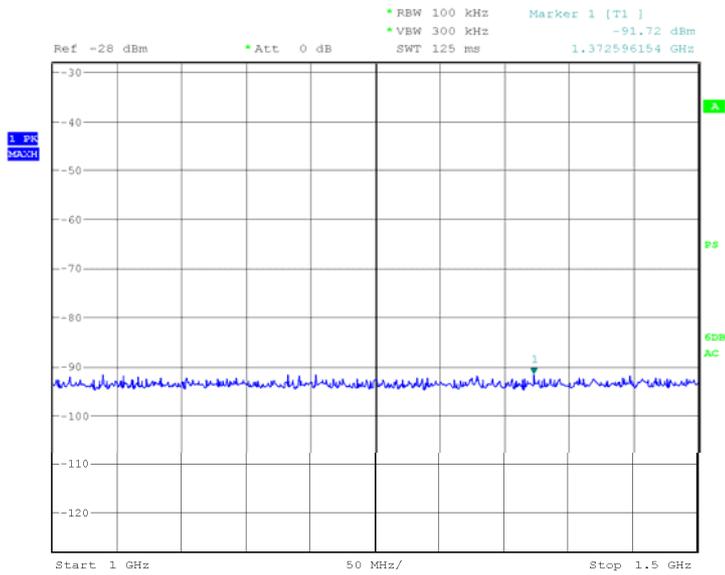


30MHz to 1GHz



Date: 7.NOV.2010 08:46:23

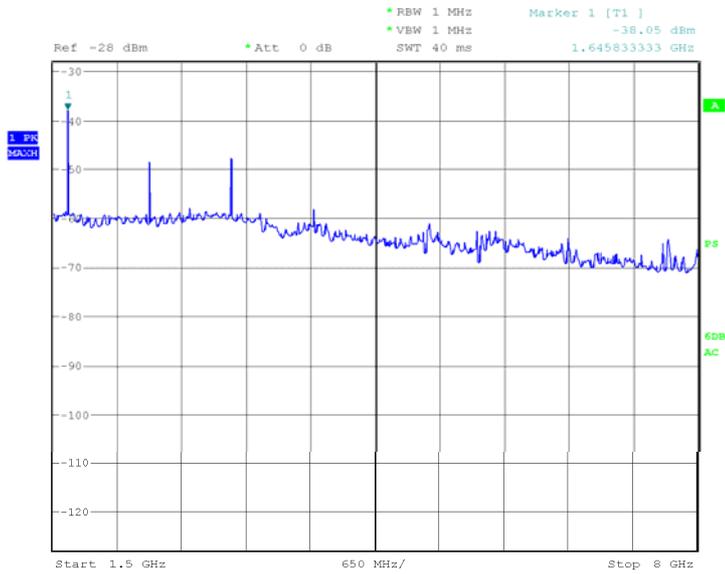
1GHz to 1.5GHz



Date: 7.NOV.2010 11:38:44

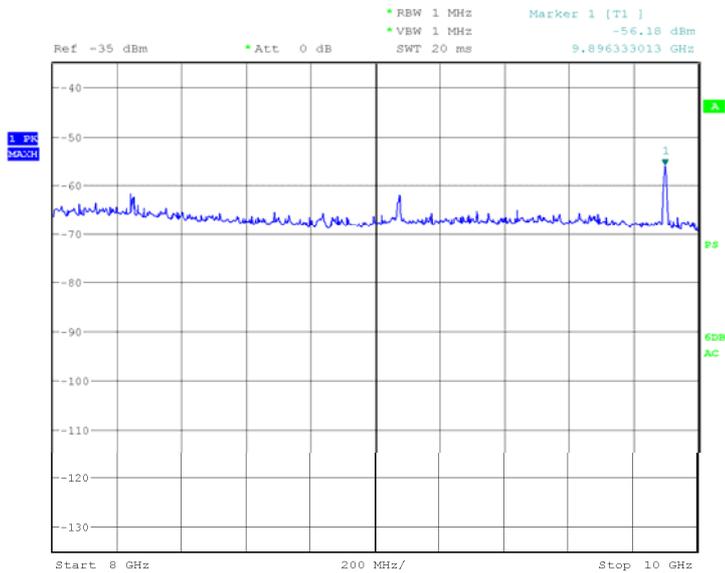


1.5GHz to 8GHz



Date: 7.NOV.2010 10:41:03

8GHz to 10GHz



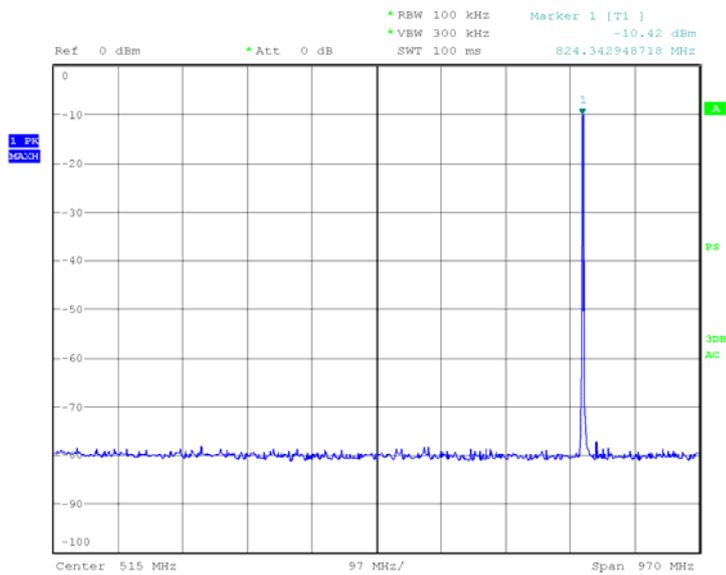
Date: 8.NOV.2010 22:47:04



**BPSK**

Frequency (MHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Peak Result (dBm)	ERP Limit (dBm)	Margin (dB)
1645	Horizontal	100	179	-36.8	-13	23.8
2474	Horizontal	102	155	-48.3	-13	35.3
3297	Horizontal	102	273	-45.0	-13	32.0
9904	Vertical	100	10	-35.7	-13	22.7

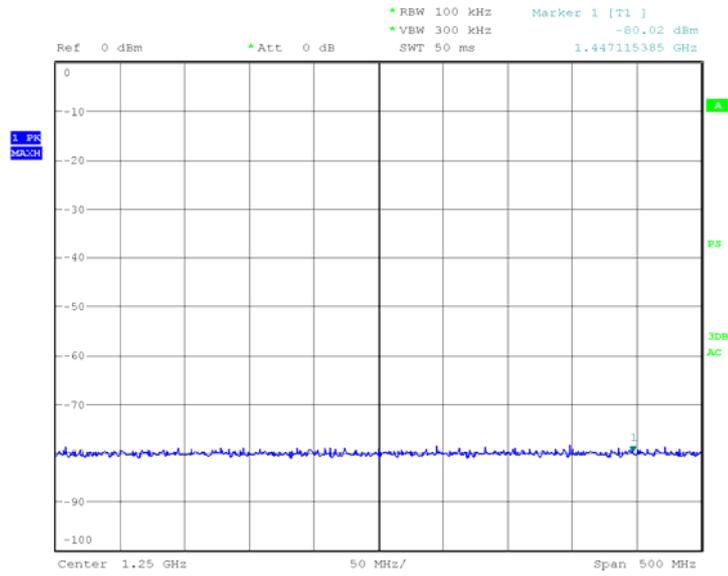
**30MHz to 1GHz**



Date: 8.NOV.2010 19:34:02

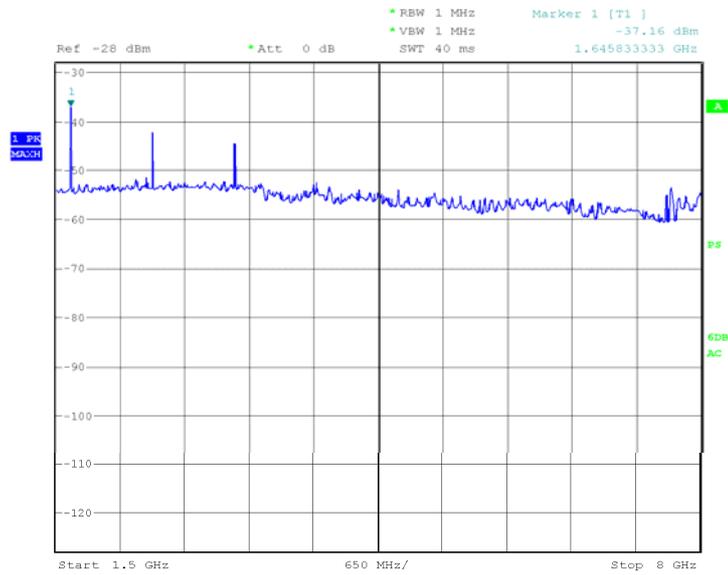


1GHz to 1.5GHz



Date: 8.NOV.2010 19:39:38

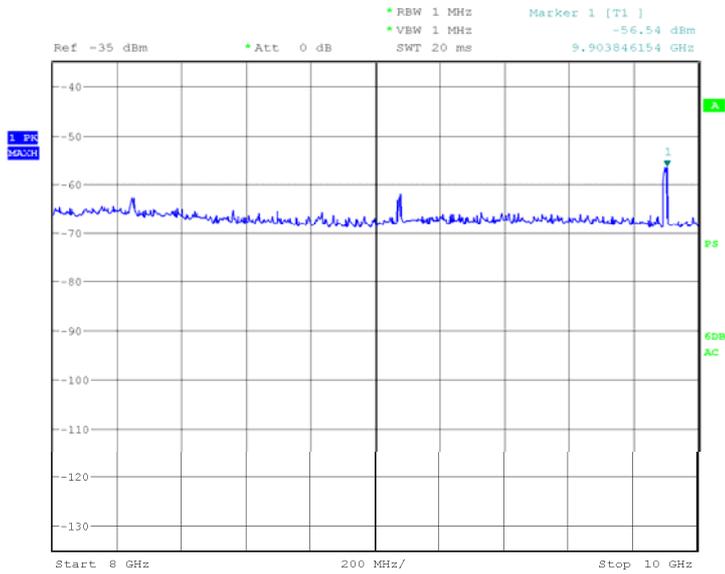
1.5GHz to 8GHz



Date: 8.NOV.2010 19:51:55



8GHz to 10GHz



Date: 8.NOV.2010 22:43:20

Configuration 1 - Mode 2

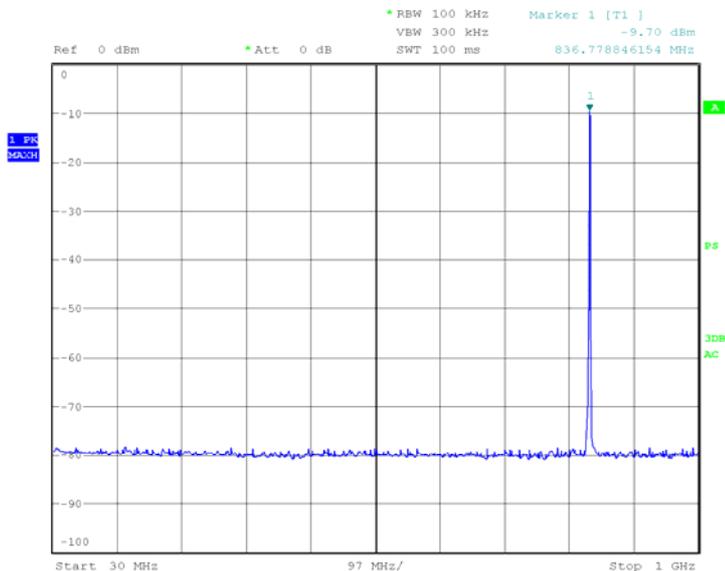
64-Ray Orthogonal

Frequency (MHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Peak Result (dBm)	ERP Limit (dBm)	Margin (dB)
1612	Horizontal	122	167	-42.0	-13	29.0
2510	Horizontal	100	317	-49.1	-13	36.1
3343	Horizontal	324	100	-48.1	-13	35.1
9205	Vertical	116	4	-42.5	-13	29.5



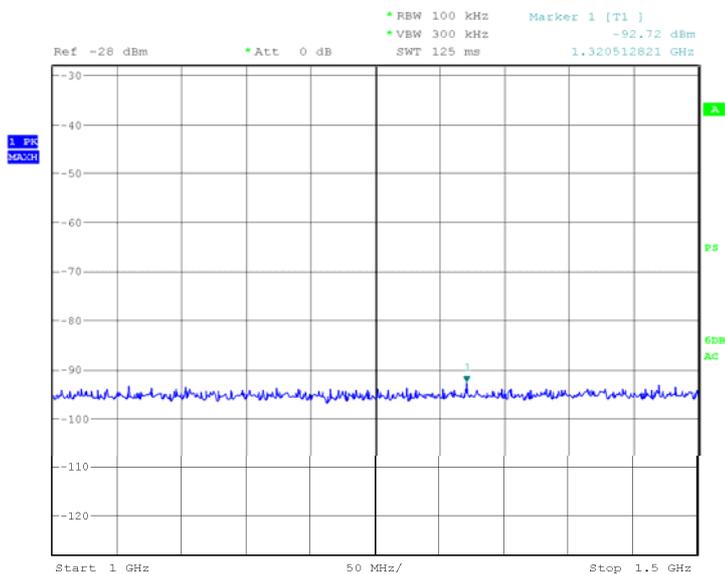
Product Service

30MHz to 1GHz



Date: 7.NOV.2010 08:49:26

1GHz to 1.5GHz

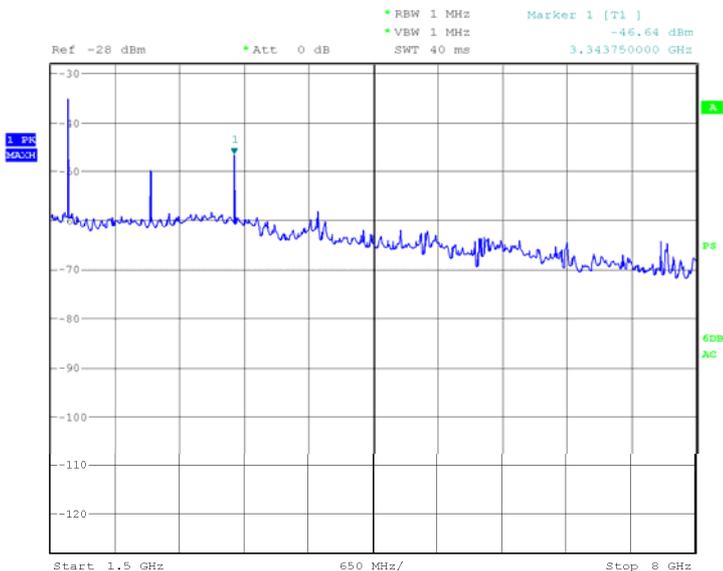


Date: 7.NOV.2010 11:39:07



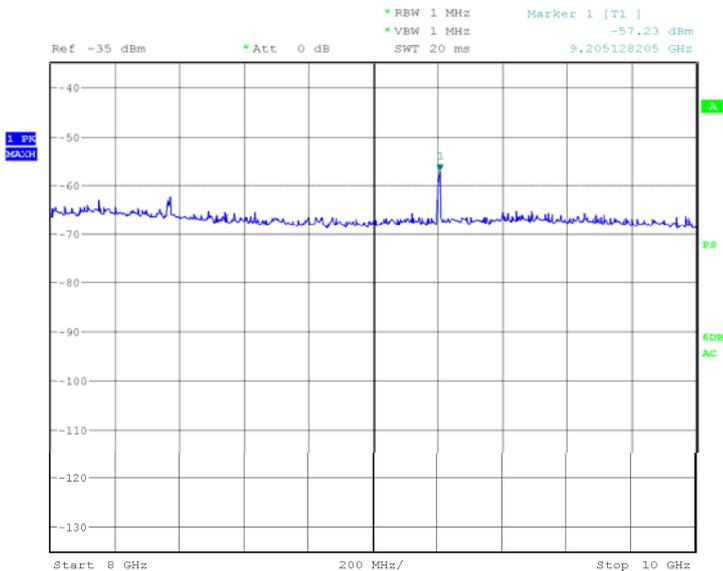
Product Service

1.5GHz to 8GHz



Date: 7.NOV.2010 10:58:15

8GHz to 10GHz



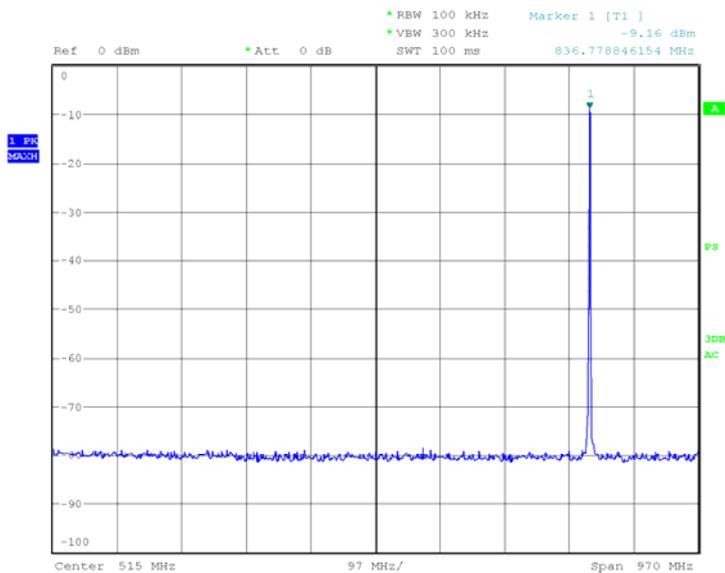
Date: 8.NOV.2010 22:50:04



**BPSK**

Frequency (MHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Peak Result (dBm)	ERP Limit (dBm)	Margin (dB)
1672	Horizontal	100	163	-31.6	-13	18.6
2508	Horizontal	120	141	-49.1	-13	36.1
3347	Horizontal	100	272	-46.5	-13	33.5
9205	Vertical	100	3	-43.0	-13	30.0

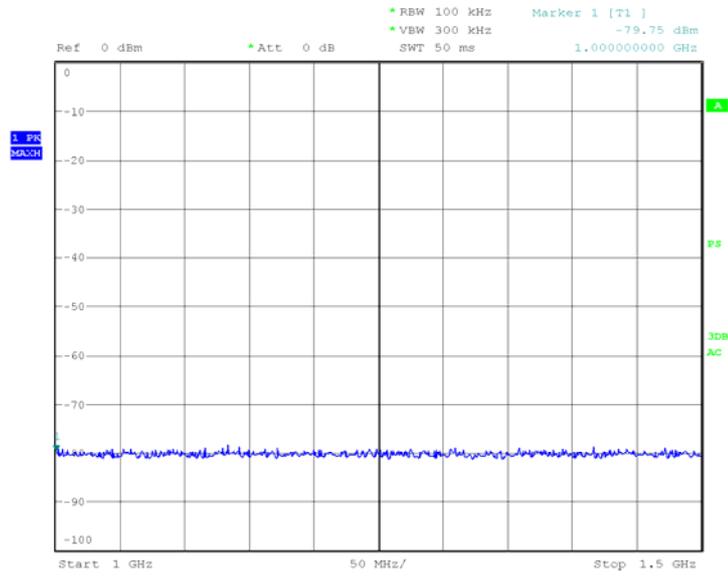
**30MHz to 1GHz**



Date: 8.NOV.2010 19:35:06

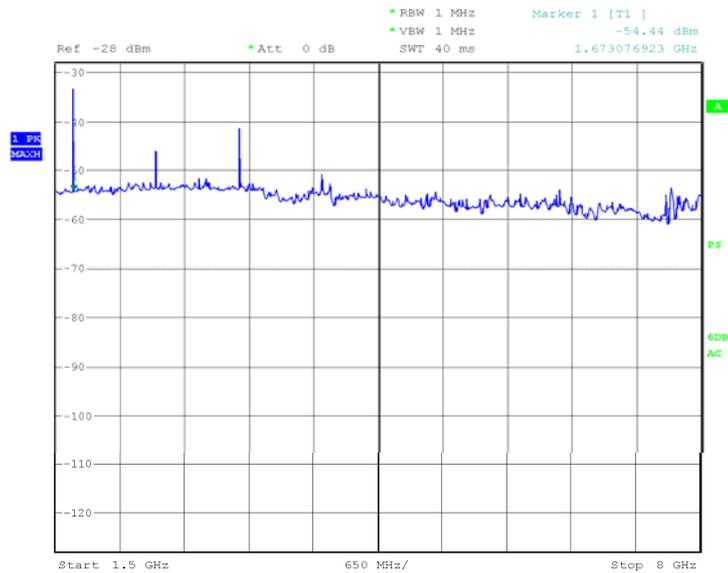


1GHz to 1.5GHz



Date: 8.NOV.2010 19:38:21

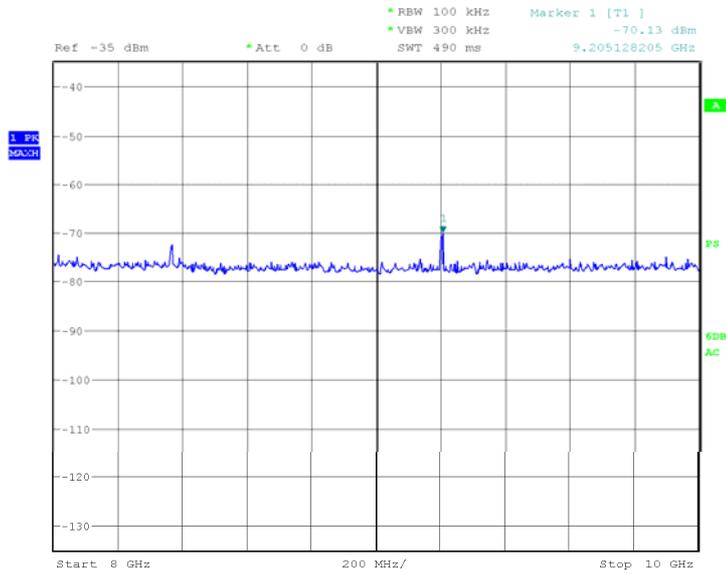
1.5GHz to 8GHz



Date: 8.NOV.2010 20:24:55



8GHz to 10GHz



Date: 8.NOV.2010 22:39:40

Configuration 1 - Mode 3

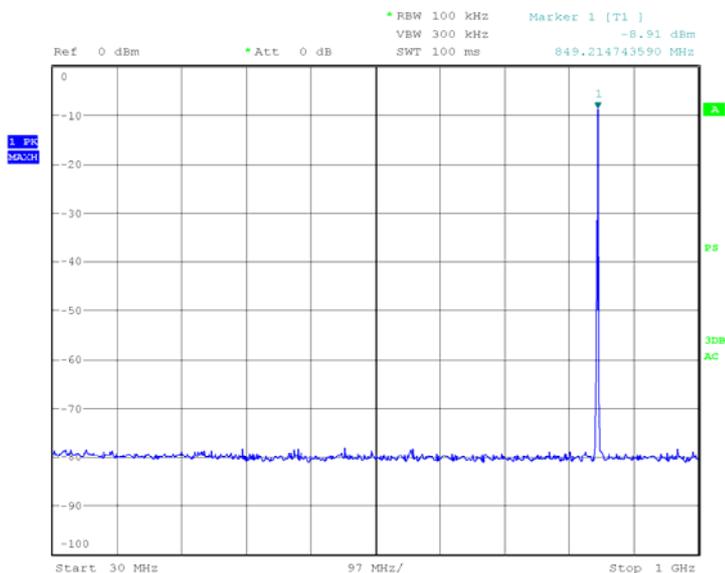
64-Ray Orthogonal

Frequency (MHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Peak Result (dBm)	ERP Limit (dBm)	Margin (dB)
1696	Horizontal	130	161	-42.7	-13	29.7
2541	Horizontal	100	301	-54.0	-13	41.0
3393	Horizontal	100	320	-48.6	-13	35.6
8480	Vertical	100	54	-42.0	-13	29.0



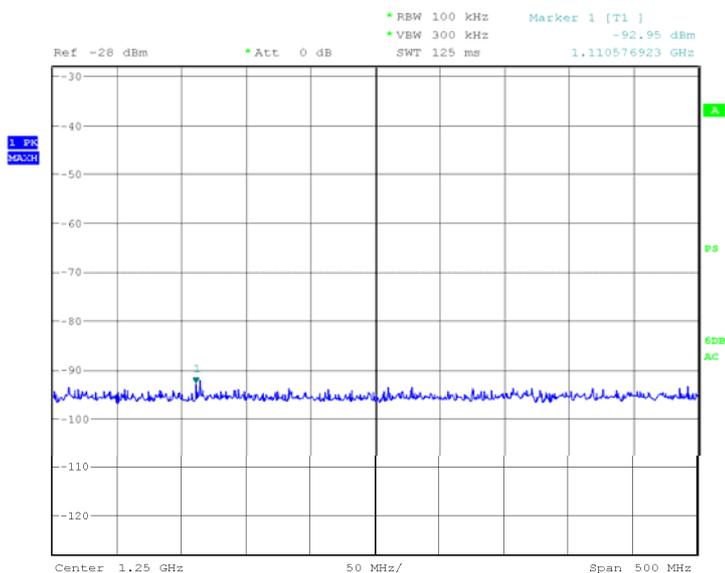
Product Service

30MHz to 1GHz



Date: 7.NOV.2010 08:51:19

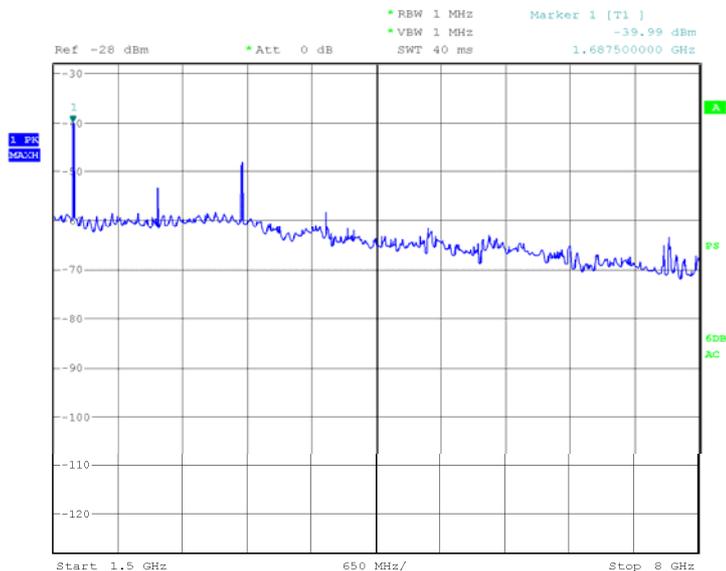
1GHz to 1.5GHz



Date: 7.NOV.2010 11:39:25

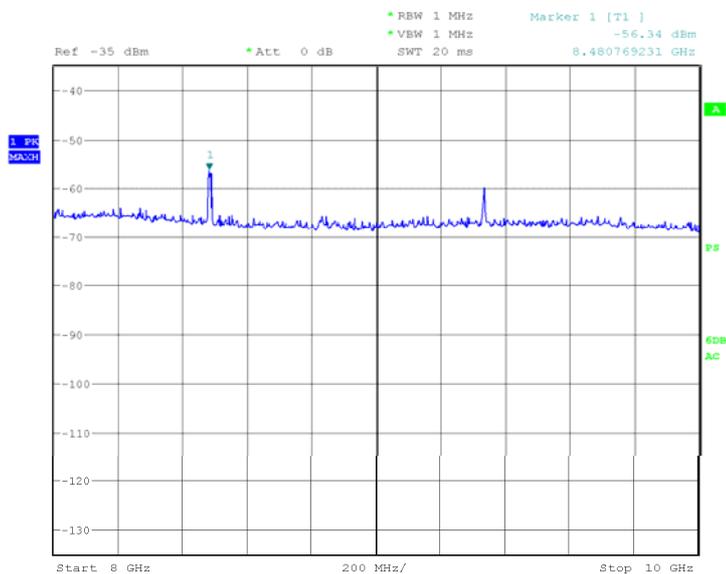


1.5GHz to 8GHz



Date: 7.NOV.2010 11:27:41

8GHz to 10GHz



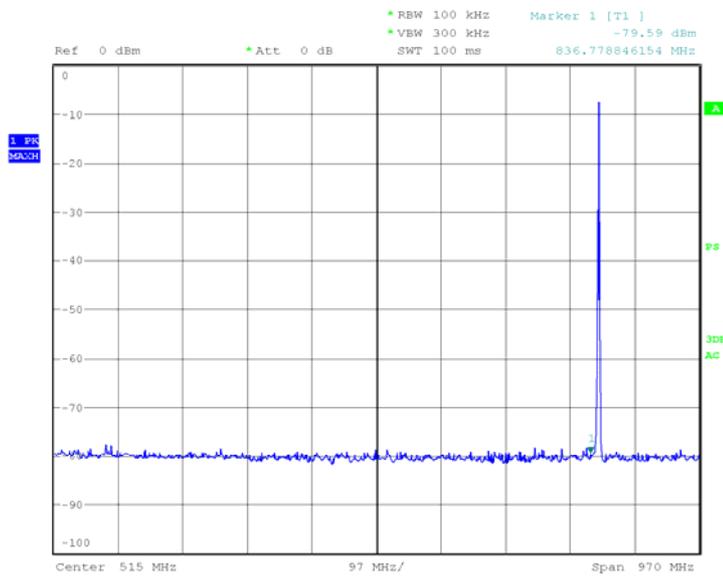
Date: 8.NOV.2010 22:53:51



**BPSK**

Frequency (MHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Peak Result (dBm)	ERP Limit (dBm)	Margin (dB)
1696	Horizontal	100	164	-37.1	-13	24.1
2544	Horizontal	100	36	-56.0	-13	43.0
3395	Horizontal	100	271	-50.9	-13	37.9
4244	Horizontal	106	33	-56.0	-13	43.0
8483	Vertical	100	87	-43.7	-13	30.7

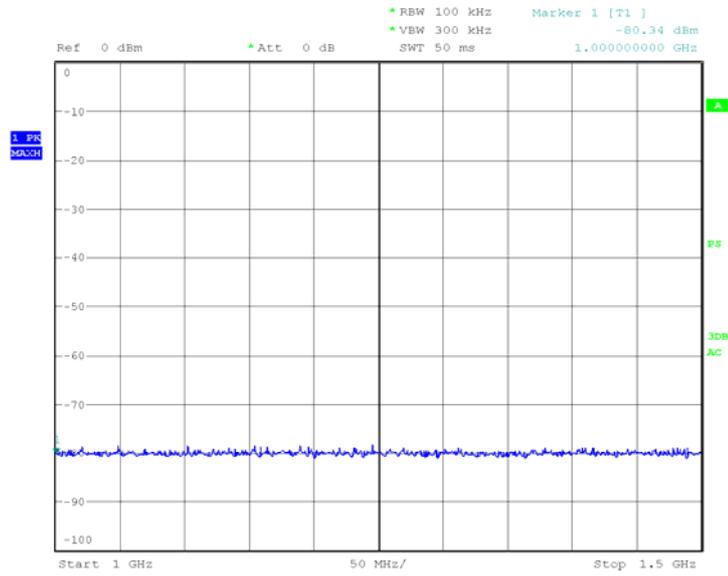
**30MHz to 1GHz**



Date: 8.NOV.2010 19:36:12

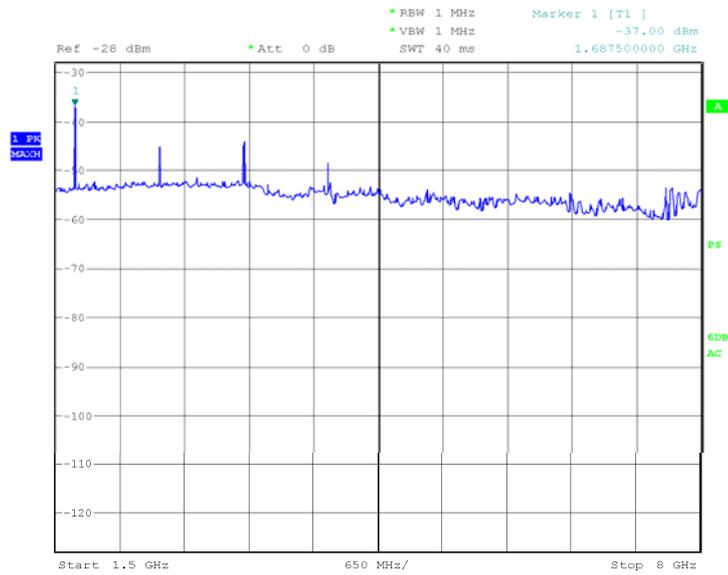


1GHz to 1.5GHz



Date: 8.NOV.2010 19:37:18

1.5GHz to 8GHz

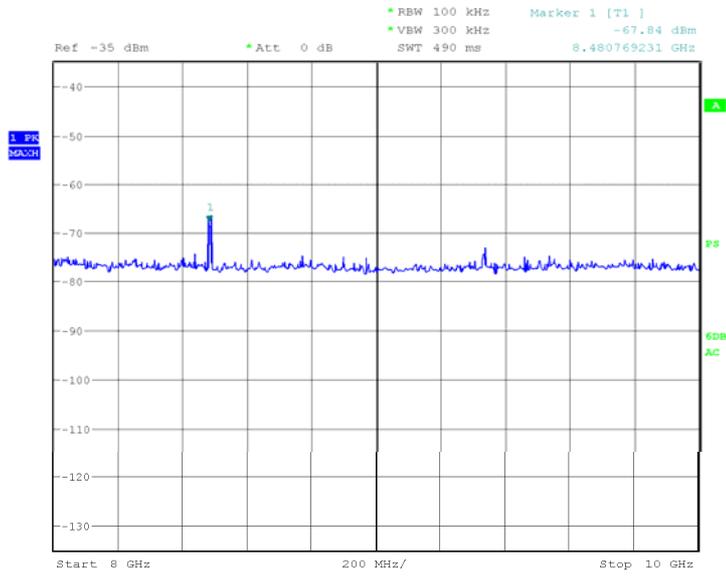


Date: 8.NOV.2010 20:45:16



Product Service

8GHz to 10GHz



Date: 8.NOV.2010 22:34:58

Limit Clause

43+10log(P) or -13 dBm



Product Service

## 2.5 CONDUCTED SPURIOUS EMISSIONS

### 2.5.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051  
FCC CFR 47 Part 22, Clause 22.917(a)

### 2.5.2 Equipment Under Test

SH-011, S/N: 000902

### 2.5.3 Date of Test and Modification State

02 November 2010 - Modification State 0

### 2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.5.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 22.

In accordance with Part 2.1051, the spurious emissions from the antenna terminal were measured. The transmitter output power was attenuated using a combination of filters and attenuators and the frequency spectrum investigated from 9 kHz to 9 GHz. The EUT was set to transmit on full power on 64-Ray Orthogonal and BPSK modulation schemes and on Bottom, Middle and Top channels. The resolution and video bandwidths were set to 100 kHz thus meeting the requirements of Part 22.917(b). The spectrum analyser detector was set to max hold.

From 9 kHz to 4 GHz, an attenuator was used. For measuring the range 4 GHz to 9 GHz an attenuator and high pass filter were used. This was to reduce saturation effects in the spectrum analyser.

The path losses across the measurement band were used as reference level offsets to ensure worst case.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1  
                          - Mode 2  
                          - Mode 3

### 2.5.6 Environmental Conditions

	02 November 2010
Ambient Temperature	24.8°C
Relative Humidity	44.1%



### 2.5.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 22 for Conducted Spurious Emissions.

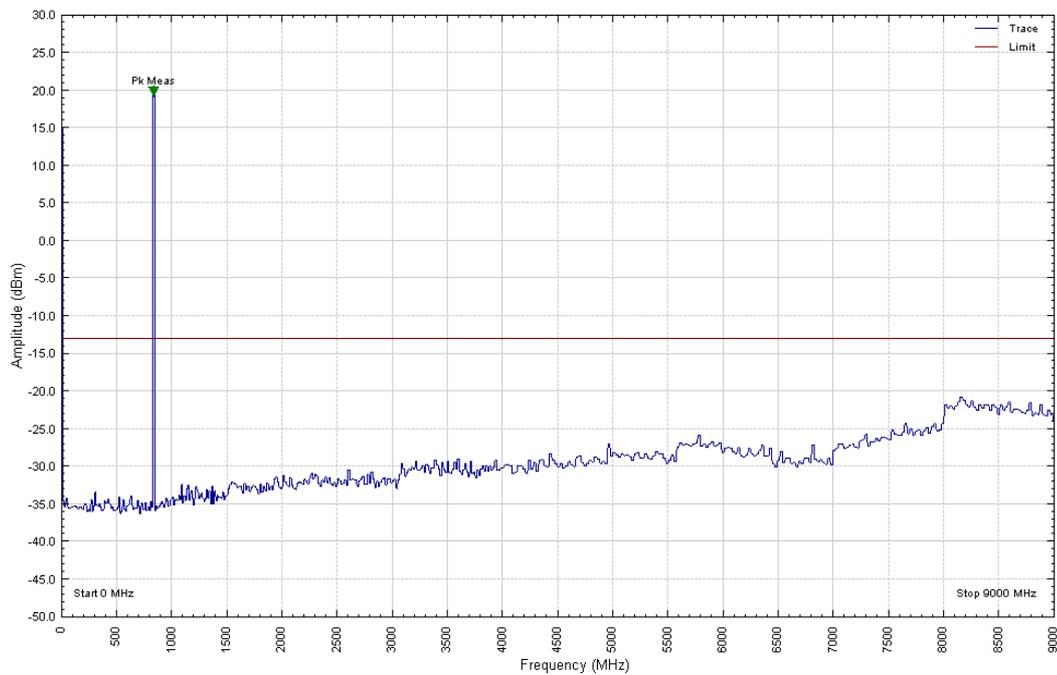
The test results are shown below.

4.0 V DC Supply

Configuration 1 – Mode 1

64-Ray Orthogonal

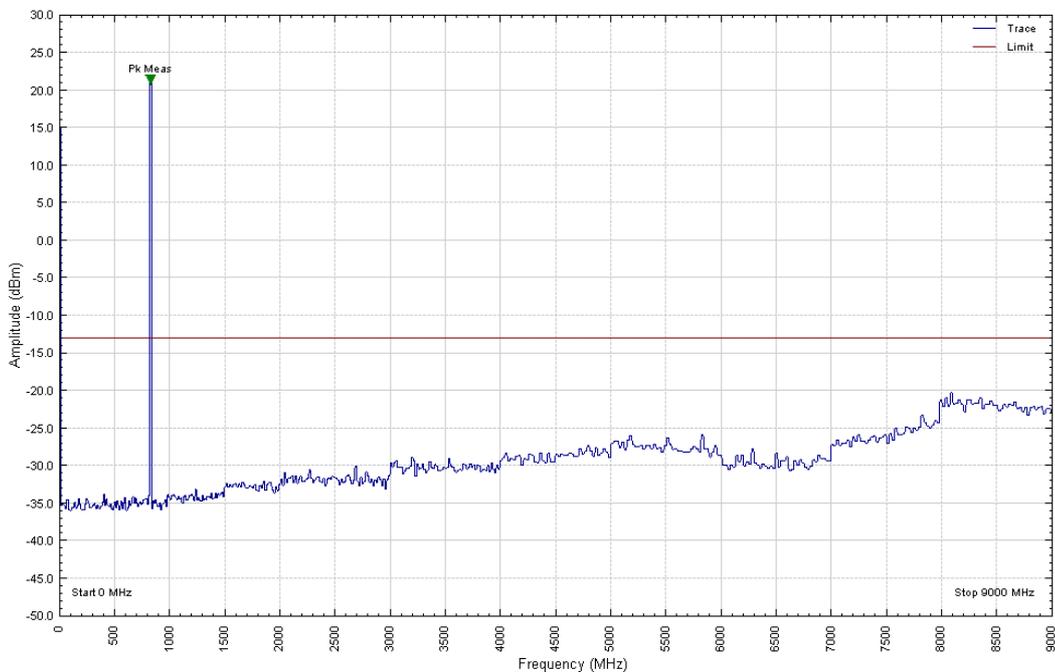
9 kHz to 9 GHz





BPSK

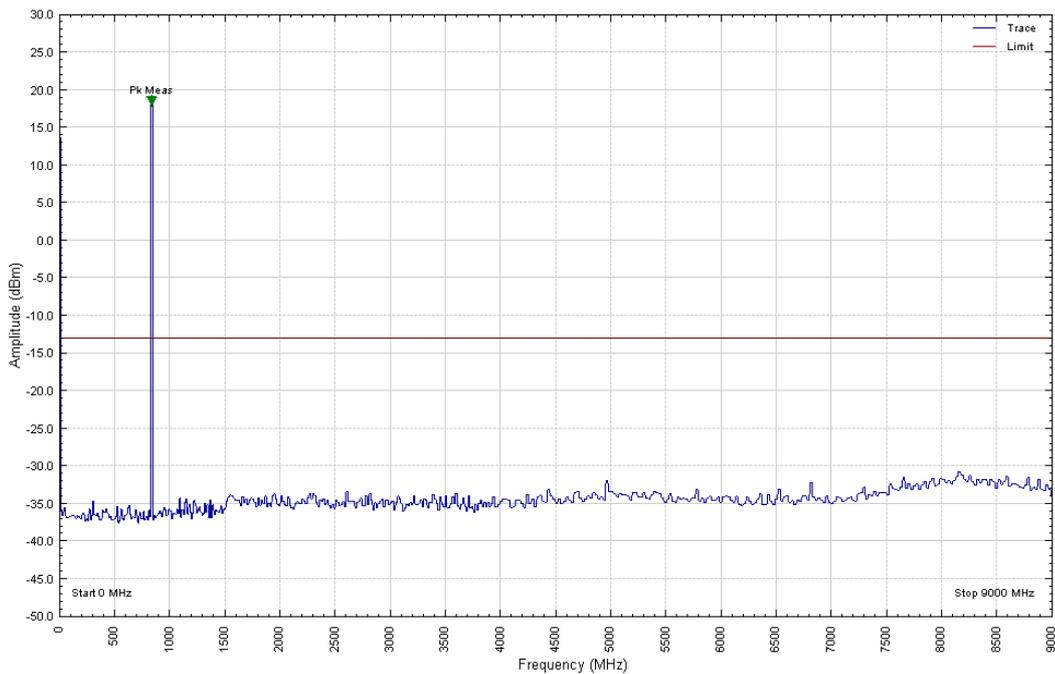
9 kHz to 9 GHz



Configuration 1 -Mode 2

64-Ray Orthogonal

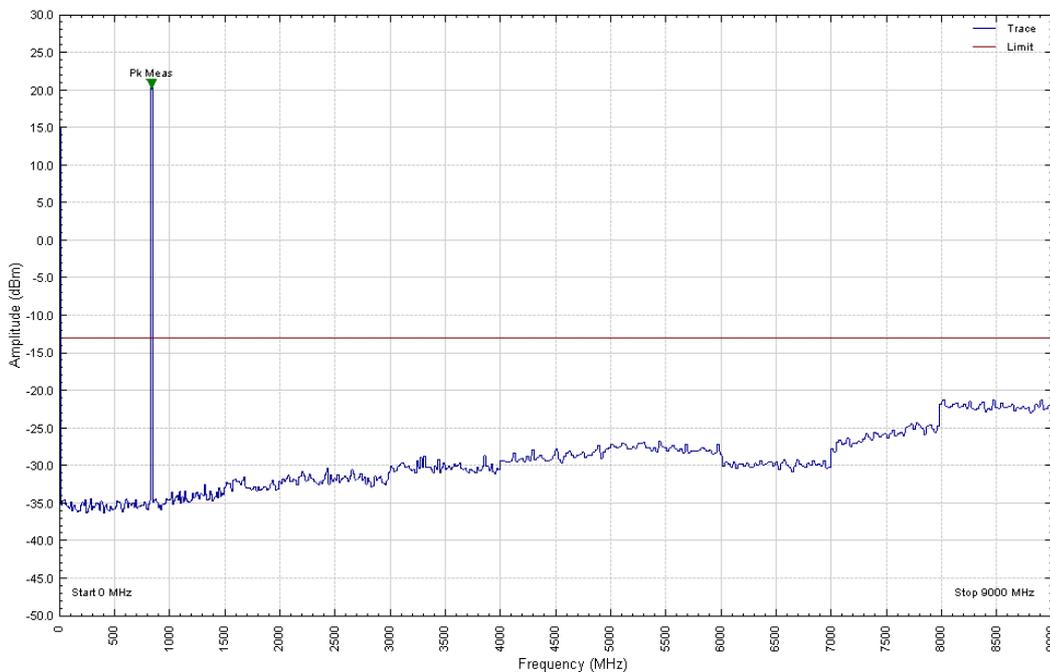
9 kHz to 9 GHz





BPSK

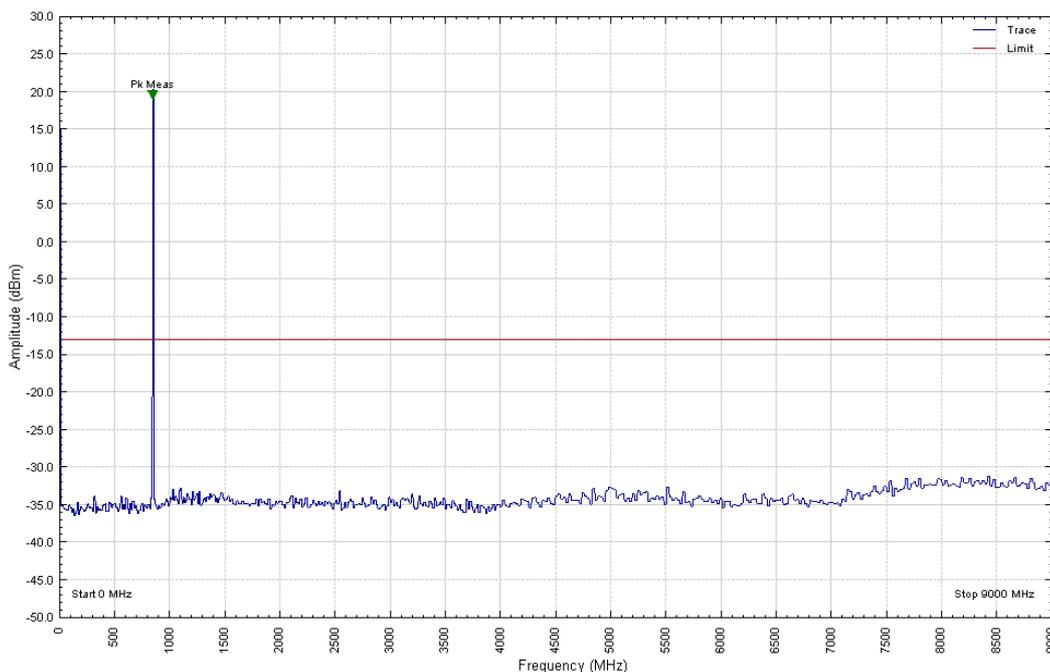
9 kHz to 9 GHz



Configuration 1 - Mode 3

64-Ray Orthogonal

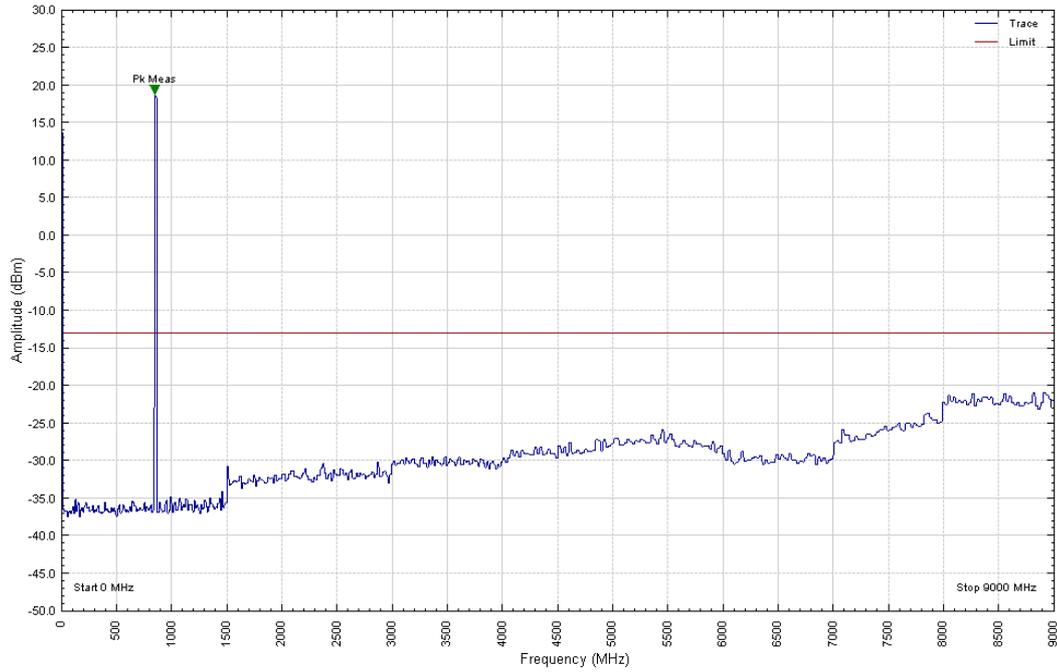
9 kHz to 9 GHz





BPSK

9 kHz to 9 GHz



Limit Clause

43+10log(P) or -13 dBm



Product Service

## 2.6 OCCUPIED BANDWIDTH

### 2.6.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1049 (h)  
FCC CFR 47 Part 22, Clause 22.917(b)

### 2.6.2 Equipment Under Test

SH-011, S/N: 000902

### 2.6.3 Date of Test and Modification State

01 November 2010 - Modification State 0

### 2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.6.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 22.

The EUT was transmitting at maximum power, with 64-Ray Orthogonal and BPSK modulation schemes. Using a resolution bandwidth of 30 kHz and a video bandwidth of 100 kHz, the -26 dBc points were established and the emission bandwidth determined.

The plot of the following pages shows the resultant display from the Spectrum Analyser.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1  
                          - Mode 2  
                          - Mode 3

### 2.6.6 Environmental Conditions

01 November 2010

Ambient Temperature 24.5°C

Relative Humidity 42.2%



Product Service

**2.6.7 Test Results**

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 22 for Occupied Bandwidth.

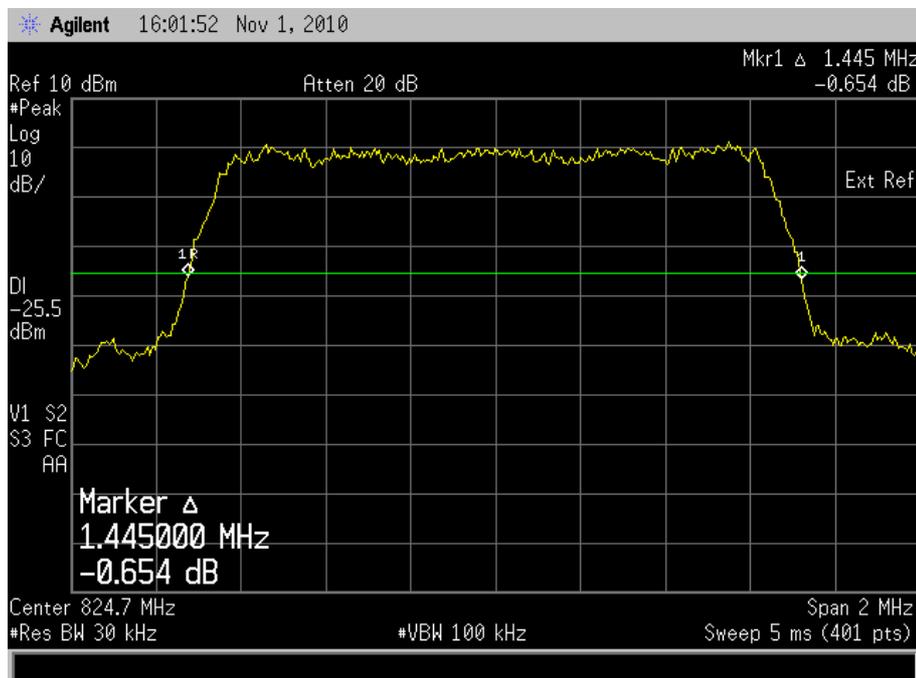
The test results are shown below.

4.0 V DC Supply

Frequency (MHz)	Mode	Occupied Bandwidth (kHz)
824.70	64-Ray Orthogonal	1445
836.52	64-Ray Orthogonal	1445
848.37	64-Ray Orthogonal	1445
824.70	BPSK	1440
836.52	BPSK	1440
848.37	BPSK	1450

Configuration 1 – Mode 1

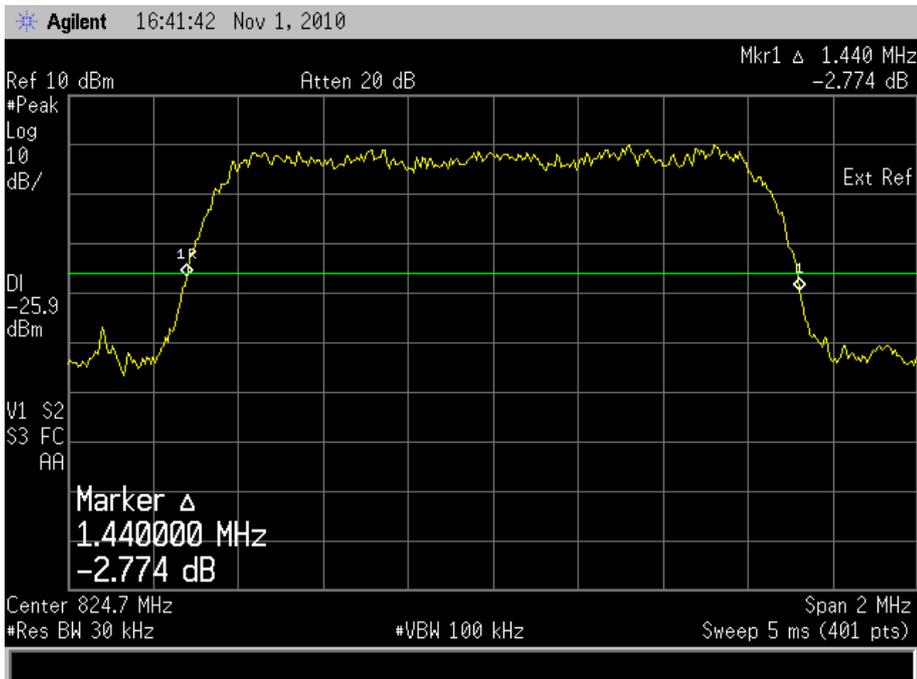
64-Ray Orthogonal





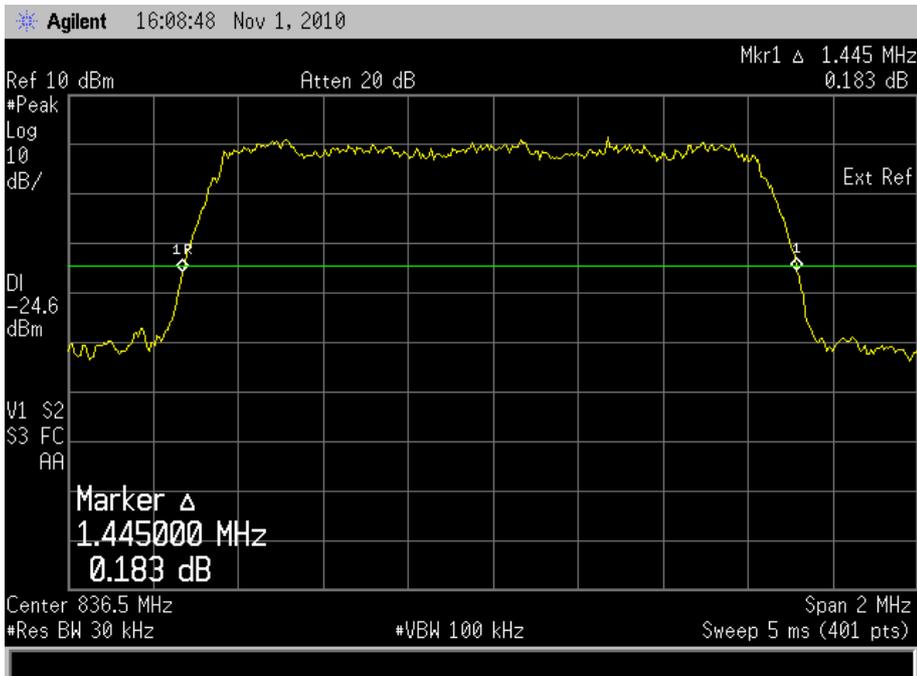
Product Service

BPSK



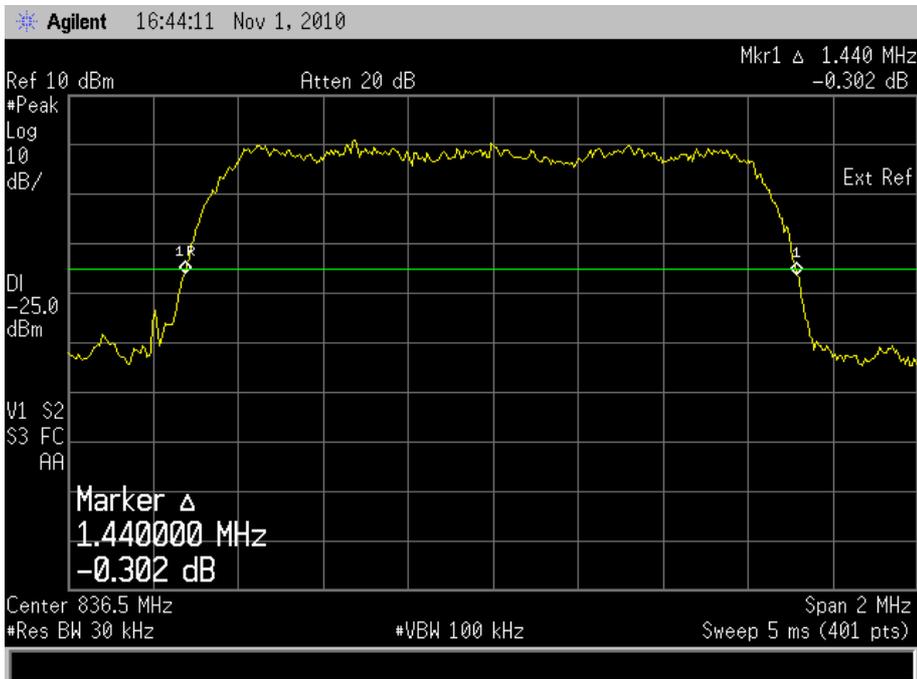
Configuration 1 - Mode 2

64-Ray Orthogonal



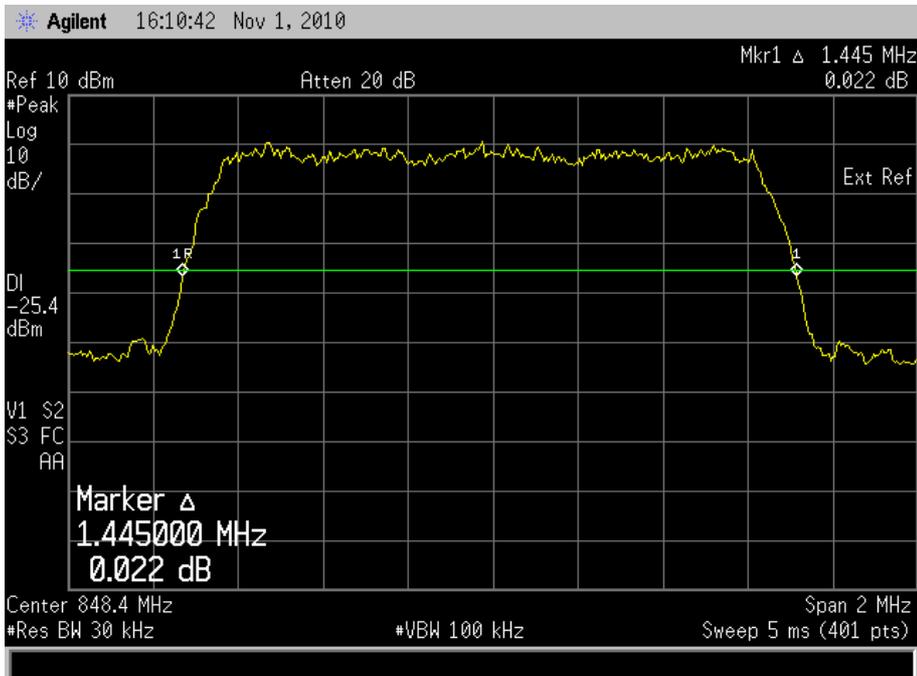


BPSK



Configuration 1 - Mode 3

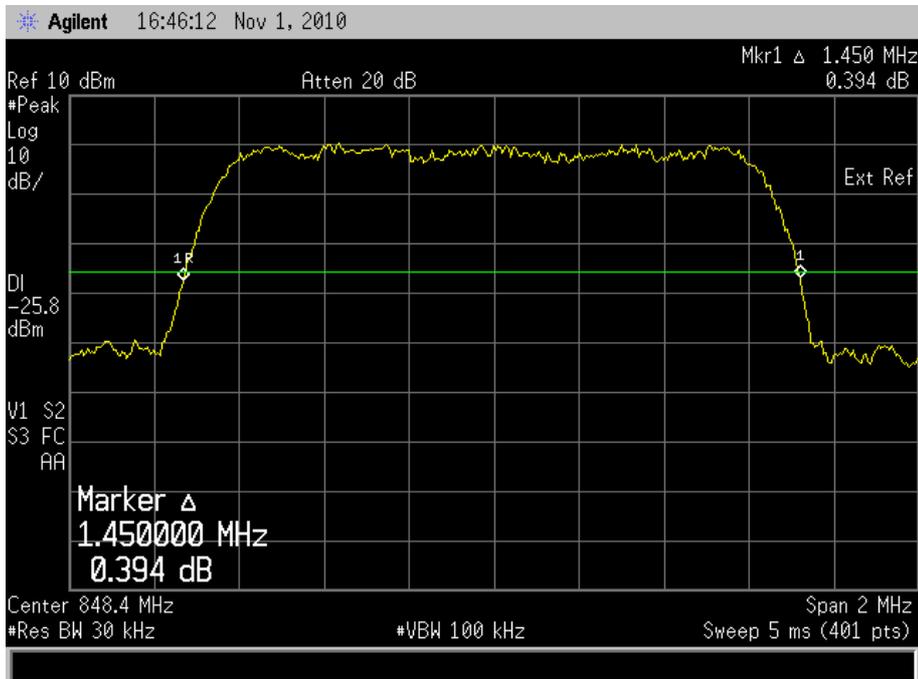
64-Ray Orthogonal





Product Service

BPSK



Limit Clause

The emission bandwidth is defined as the width of the signal between two points, one below the carrier centre frequency and one above the carrier centre frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.



Product Service

## **2.7 MODULATION CHARACTERISTICS**

### **2.7.1 Specification Reference**

FCC CFR 47 Part 2, Clause 2.1047(d)

### **2.7.2 Equipment Under Test**

SH-011, S/N: 000902

### **2.7.3 Date of Test and Modification State**

02 November 2010 - Modification State 0

### **2.7.4 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.7.5 Test Method and Operating Modes**

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2.

Plots are shown on the following pages showing the EUT transmitting with the display in the time domain.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 2

### **2.7.6 Environmental Conditions**

02 November 2010

Ambient Temperature 24.8°C

Relative Humidity 44.1%



Product Service

**2.7.7 Test Results**

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 for Modulation Characteristics.

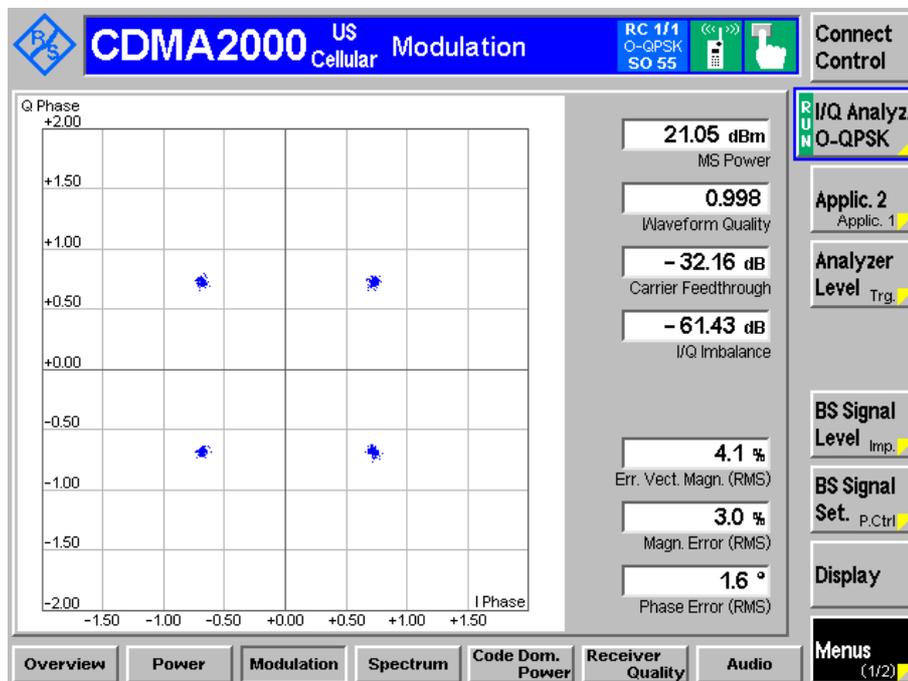
The test results are shown below.

4.0 V DC Supply

Configuration 1 – Mode 2

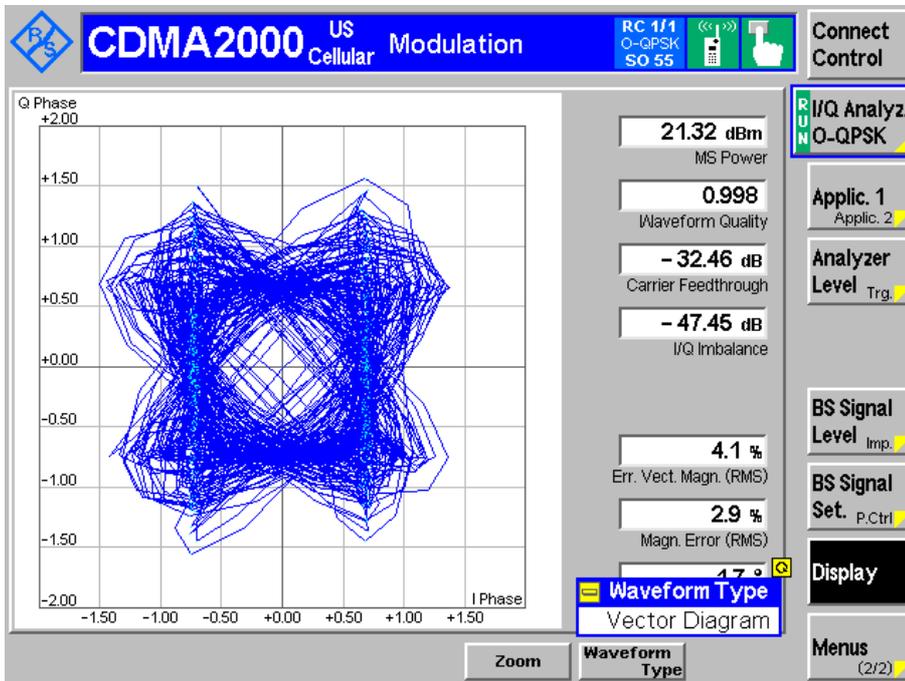
64-Ray Orthogonal

Constellation Diagram

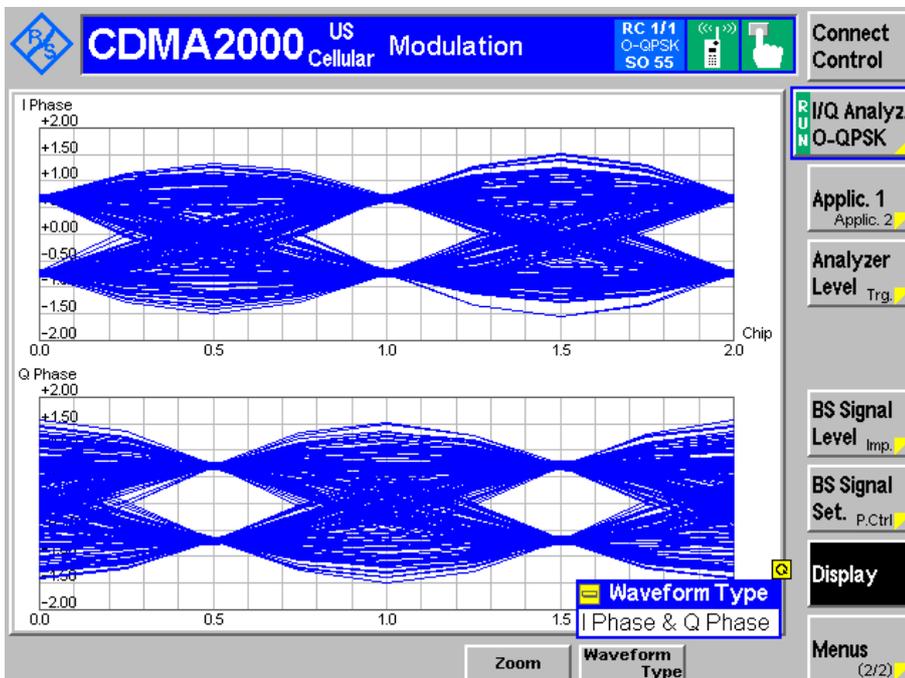




Vector Diagram



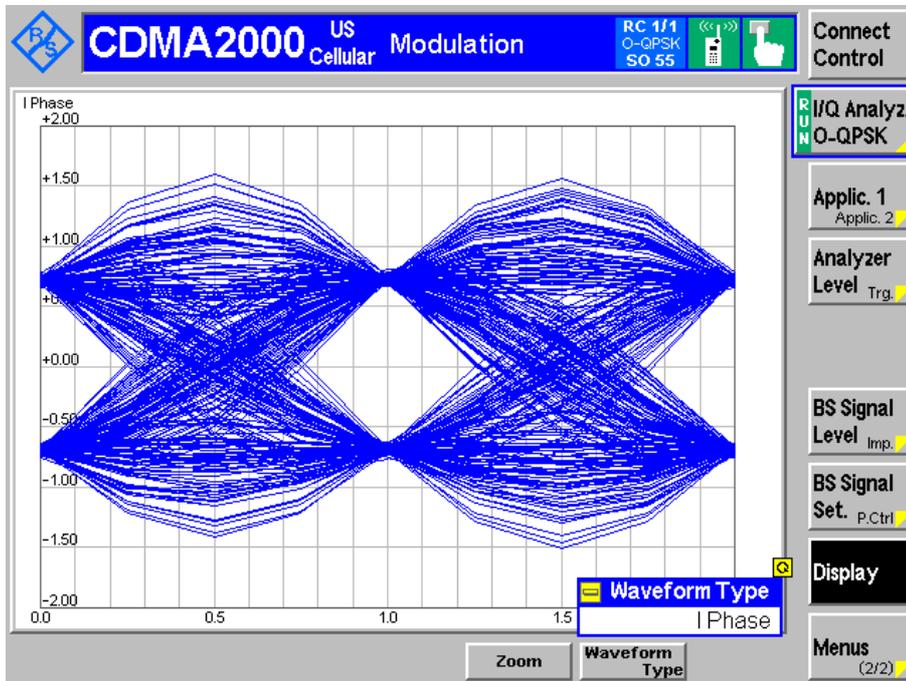
I and Q Phase Diagram



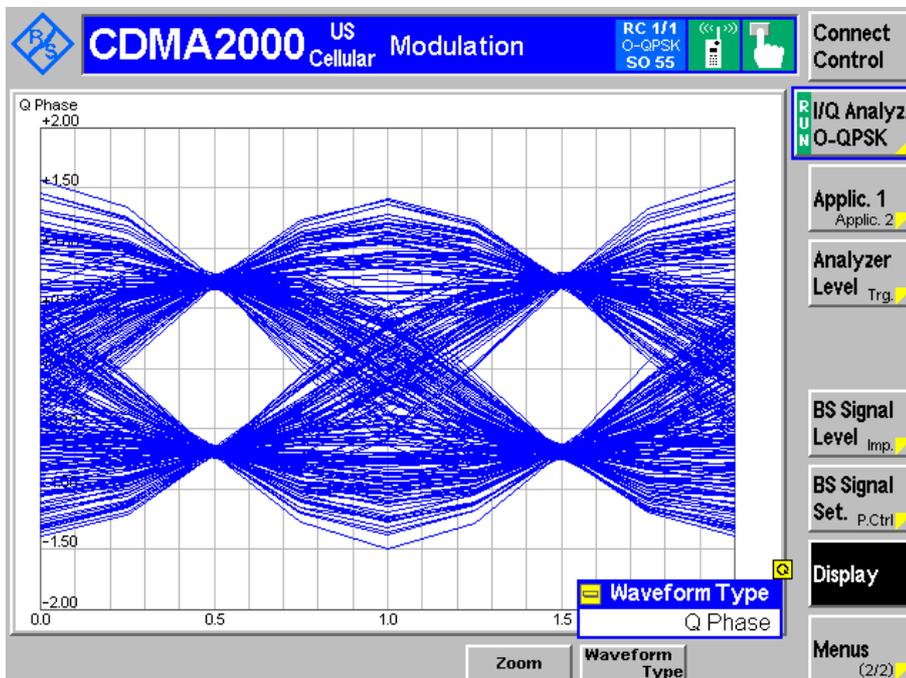


Product Service

I Phase Diagram



Q Phase Diagram

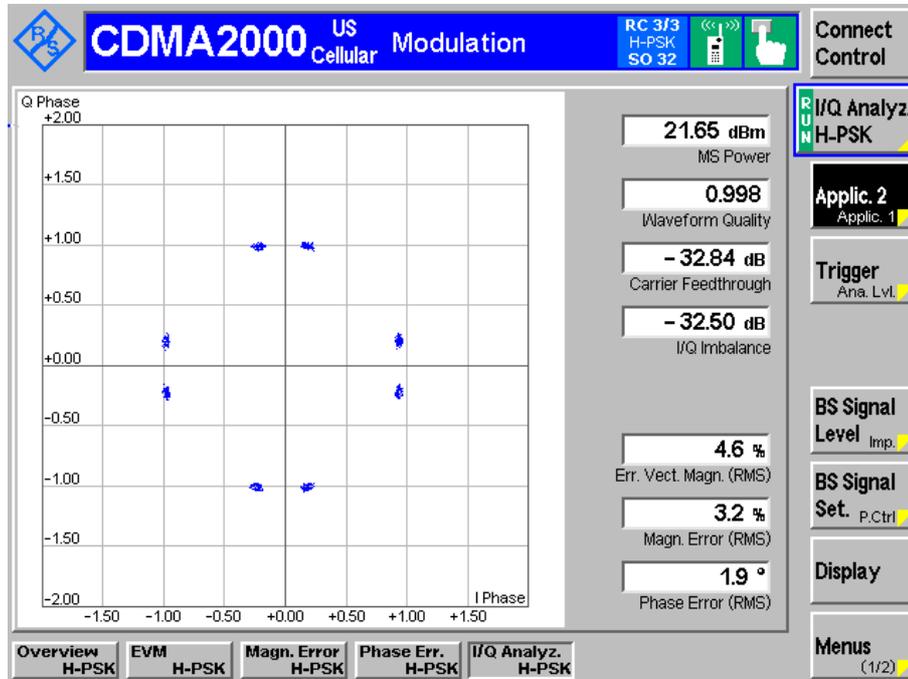




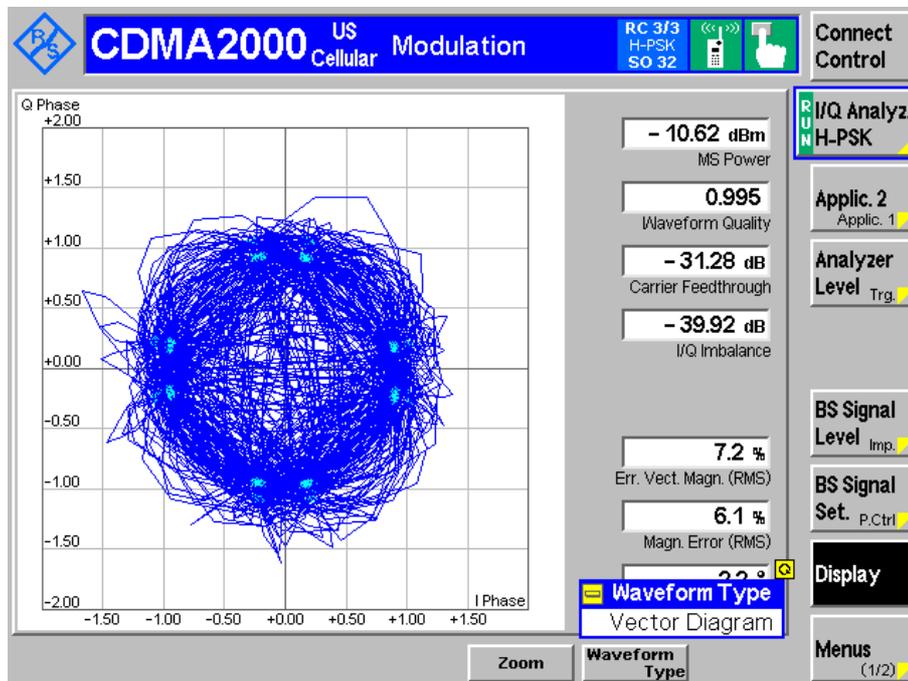
Product Service

BPSK

Constellation Diagram

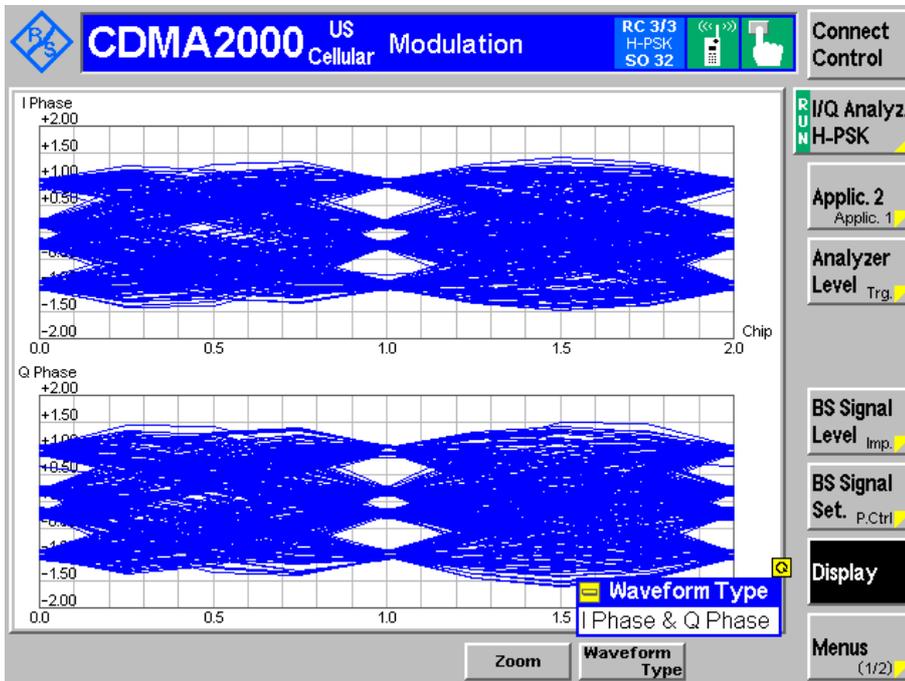


Vector Diagram

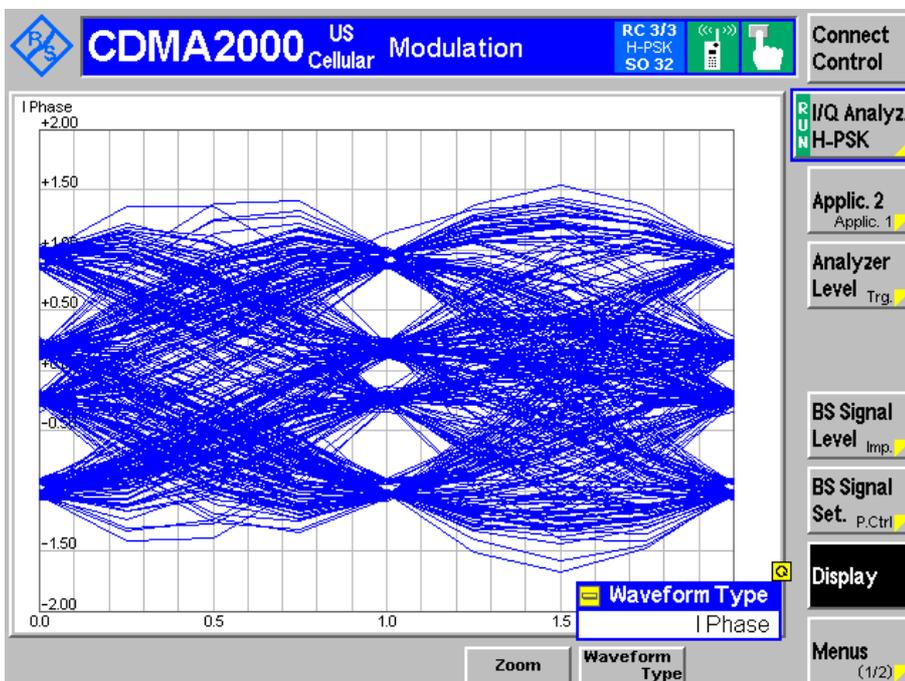




I and Q Phase Diagram



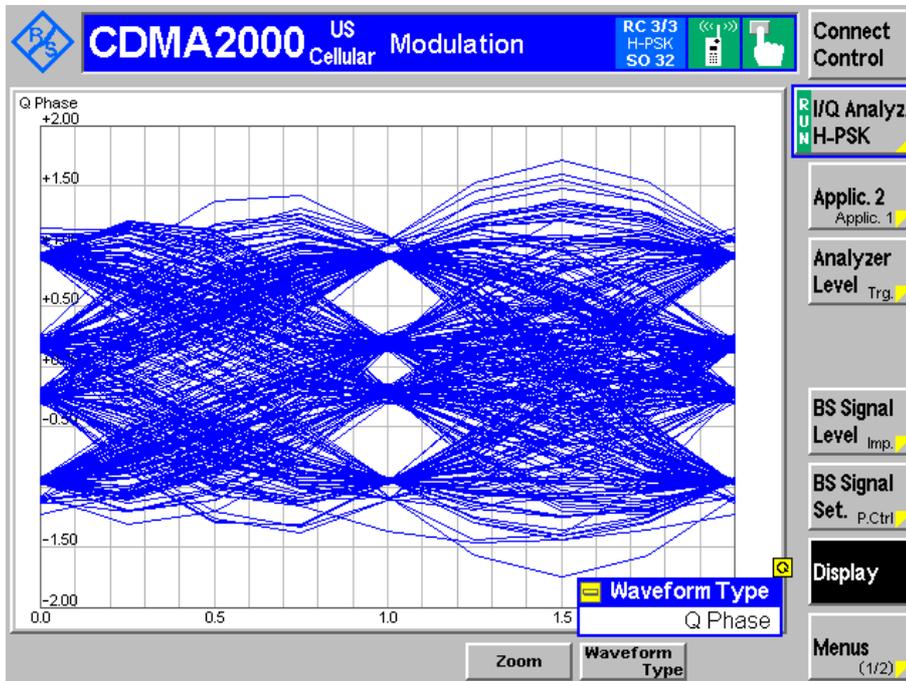
I Phase Diagram





Product Service

Q Phase Diagram



Limit Clause

A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.



Product Service

## **2.8 FREQUENCY STABILITY UNDER TEMPERATURE VARIATIONS**

### **2.8.1 Specification Reference**

FCC CFR 47 Part 2, Clause 2.1055  
FCC CFR 47 Part 22, Clause 22.355

### **2.8.2 Equipment Under Test**

SH-011, S/N: 000902

### **2.8.3 Date of Test and Modification State**

03 November 2010 - Modification State 0

### **2.8.4 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.8.5 Test Method and Operating Modes**

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 22.

The EUT was set to transmit on maximum power with 64-Ray Orthogonal and BPSK modulation schemes. A digital communication analyser (CMU 200), was used to measure the frequency error. The maximum result was taken over 200 bursts. The temperature was adjusted between -30°C and +50°C in 10° steps as per 2.1055.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 2

### **2.8.6 Environmental Conditions**

	03 November 2010
Ambient Temperature	225.°C
Relative Humidity	44.6%



Product Service

**2.8.7 Test Results**

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 22 for Frequency Stability Under Temperature Variations.

The test results are shown below.

Configuration 1 - Mode 2

4.0 V DC Supply

Temperature Interval (°C)	Test Frequency (MHz)	Mode	Deviation (Hz)	Limit (kHz)
-30	836.52	64-Ray Orthogonal	21	±2.5ppm or ±2.091
-20	836.52	64-Ray Orthogonal	9	±2.5ppm or ±2.091
-10	836.52	64-Ray Orthogonal	29	±2.5ppm or ±2.091
0	836.52	64-Ray Orthogonal	30	±2.5ppm or ±2.091
+10	836.52	64-Ray Orthogonal	30	±2.5ppm or ±2.091
+20	836.52	64-Ray Orthogonal	28	±2.5ppm or ±2.091
+30	836.52	64-Ray Orthogonal	29	±2.5ppm or ±2.091
+40	836.52	64-Ray Orthogonal	28	±2.5ppm or ±2.091
+50	836.52	64-Ray Orthogonal	28	±2.5ppm or ±2.091
-30	836.52	BPSK	16	±2.5ppm or ±2.091
-20	836.52	BPSK	17	±2.5ppm or ±2.091
-10	836.52	BPSK	17	±2.5ppm or ±2.091
0	836.52	BPSK	18	±2.5ppm or ±2.091
+10	836.52	BPSK	19	±2.5ppm or ±2.091
+20	836.52	BPSK	22	±2.5ppm or ±2.091
+30	836.52	BPSK	18	±2.5ppm or ±2.091
+40	836.52	BPSK	29	±2.5ppm or ±2.091
+50	836.52	BPSK	16	±2.5ppm or ±2.091

Limit Clause

Frequency Range (MHz)	Base, Fixed (ppm)	Mobile ≤ 3 watts (ppm)	Mobile ≤ 3 watts (ppm)
25 to 50	20	20	50
50 to 450	5	5	50
450 to 512	2.5	5	5
821 to 896	1.5	2.5	2.5
928 to 929	5.0	n/a	n/a
929 to 960	1.5	n/a	n/a
2110 to 2220	10	n/a	n/a



Product Service

## **2.9 FREQUENCY STABILITY UNDER VOLTAGE VARIATIONS**

### **2.9.1 Specification Reference**

FCC CFR 47 Part 2, Clause 2.1055  
FCC CFR 47 Part 22, Clause 22.355

### **2.9.2 Equipment Under Test**

SH-011, S/N: 000902

### **2.9.3 Date of Test and Modification State**

03 November 2010 - Modification State 0

### **2.9.4 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.9.5 Test Method and Operating Modes**

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 22.

The EUT was set to transmit on maximum power on 64-Ray Orthogonal and BPSK modulation schemes. A digital communication analyser (CMU200), was used to measure the frequency error. The maximum result was taken over 200 bursts.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 2

### **2.9.6 Environmental Conditions**

03 November 2010

Ambient Temperature 24.1°C

Relative Humidity 43.8%



Product Service

**2.9.7 Test Results**

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 22 for Frequency Stability Under Voltage Variations.

The test results are shown below.

Configuration 1 - Mode 2

DC Voltage (V)	Test Frequency (MHz)	Mode	Deviation (Hz)	Deviation Limit (kHz)
3.7	836.52	64-Ray Orthogonal	30	±2.5ppm or ±2.091
4.0	836.52	64-Ray Orthogonal	28	±2.5ppm or ±2.091
3.7	836.52	BPSK	22	±2.5ppm or ±2.091
4.0	836.52	BPSK	22	±2.5ppm or ±2.091

Limit Clause

Frequency Range (MHz)	Base, Fixed (ppm)	Mobile ≤ 3 watts (ppm)	Mobile ≤ 3 watts (ppm)
25 to 50	20	20	50
50 to 450	5	5	50
450 to 512	2.5	5	5
821 to 896	1.5	2.5	2.5
928 to 929	5.0	n/a	n/a
929 to 960	1.5	n/a	n/a
2110 to 2220	10	n/a	n/a



Product Service

### **SECTION 3**

#### **TEST EQUIPMENT USED**



### 3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
<b>Section 2.1 - Spurious Emissions at Band Edge</b>					
True RMS Multimeter	Fluke	79 Series III	411	12	26-Jul-2011
Power Divider	Weinschel	1506A	603	12	18-Mar-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	9-Mar-2011
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	13-Oct-2011
Programmable Power Supply	Iso-tech	IPS 2010	2436	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	4-Dec-2010
<b>Section 2.2 – Effective Radiated Power</b>					
Antenna (Bilog)	Schaffner	CBL6143	287	24	19-Jan-2012
Screened Room (5)	Rainford	Rainford	1545	36	11-Feb-2011
Mast Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Turntable/Mast Controller	EMCO	2090	1607	-	TU
Antenna (Bilog)	Chase	CBL6143	2904	24	4-Dec-2011
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	12-Aug-2011
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	12	TU
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3703	12	26-Jan-2011
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	12	10-Aug-2011
<b>Section 2.3 - Maximum Peak Output Power - Conducted</b>					
Peak Power Analyser	Hewlett Packard	8990A	107	12	10-Feb-2011
Antenna (Bilog)	Schaffner	CBL6143	287	24	19-Jan-2012
True RMS Multimeter	Fluke	79 Series III	411	12	26-Jul-2011
Power Divider	Weinschel	1506A	603	12	18-Mar-2011
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	13-Oct-2011
Screened Room (5)	Rainford	Rainford	1545	36	11-Feb-2011
Mast Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Turntable/Mast Controller	EMCO	2090	1607	-	TU
Programmable Power Supply	Iso-tech	IPS 2010	2436	-	O/P Mon
Antenna (Bilog)	Chase	CBL6143	2904	24	4-Dec-2011
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	12-Aug-2011
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	12	TU
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3703	12	26-Jan-2011
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	12	10-Aug-2011



Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
<b>Section 2.4 – Emissions Limitations for Cellular Equipment</b>					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	11-Nov-2010
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	11-Nov-2010
Antenna (Bilog)	Schaffner	CBL6143	287	24	19-Jan-2012
Pre-Amplifier	Phase One	PS04-0086	1533	12	15-Sep-2011
Screened Room (5)	Rainford	Rainford	1545	36	11-Feb-2011
Mast Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Turntable/Mast Controller	EMCO	2090	1607	-	TU
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	30-Nov-2010
Antenna (Bilog)	Chase	CBL6143	2904	24	4-Dec-2011
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	12-Aug-2011
Amplifier (1 - 8GHz)	Phase One	PS06-0060	3175	12	2-Jul-2011
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	4-Dec-2010
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	12	TU
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3703	12	26-Jan-2011
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	12	10-Aug-2011
<b>Section 2.5 - Conducted Spurious Emissions</b>					
LISN (1 Phase)	Chase	MN 2050	336	12	25-Mar-2011
True RMS Multimeter	Fluke	79 Series III	411	12	26-Jul-2011
Transient Limiter	Hewlett Packard	11947A	1032	12	22-Jun-2011
Screened Room (5)	Rainford	Rainford	1545	36	11-Feb-2011
Programmable Power Supply	Iso-tech	IPS 2010	2436	-	O/P Mon
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Nov-2010
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	30-Nov-2010
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	28-Nov-2010
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	12	TU
<b>Section 2.6 - Occupied Bandwidth</b>					
True RMS Multimeter	Fluke	79 Series III	411	12	26-Jul-2011
Power Divider	Weinschel	1506A	603	12	18-Mar-2011
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	13-Oct-2011
Programmable Power Supply	Iso-tech	IPS 2010	2436	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
<b>Section 2.7 - Modulation Characteristics</b>					
True RMS Multimeter	Fluke	79 Series III	411	12	26-Jul-2011
Power Divider	Weinschel	1506A	603	12	18-Mar-2011
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	13-Oct-2011
Programmable Power Supply	Iso-tech	IPS 2010	2436	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011



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Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
<b>Section 2.8 - Frequency Stability Under Temperature Variations</b>					
True RMS Multimeter	Fluke	79 Series III	411	12	26-Jul-2011
Temperature Chamber	Montford	2F3	467	-	O/P Mon
Power Divider	Weinschel	1506A	603	12	18-Mar-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	9-Mar-2011
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	13-Oct-2011
Programmable Power Supply	Iso-tech	IPS 2010	2436	-	O/P Mon
Thermocouple Thermometer	Fluke	51	3172	12	12-Jul-2011
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
<b>Section 2.9 - Frequency Stability Under Voltage Variations</b>					
True RMS Multimeter	Fluke	79 Series III	411	12	26-Jul-2011
Temperature Chamber	Montford	2F3	467	-	O/P Mon
Power Divider	Weinschel	1506A	603	12	18-Mar-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	9-Mar-2011
Multimeter	Hewlett Packard	3456A	1317	-	Transfer Standard (TU)
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	13-Oct-2011
Programmable Power Supply	Iso-tech	IPS 2010	2436	-	O/P Mon
Thermocouple Thermometer	Fluke	51	3172	12	12-Jul-2011
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011

TU – Traceability Unscheduled

O/P Mon – Output monitored using calibrated equipment.



### 3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	Frequency / Parameter	MU
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.1dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Conducted Emissions, LISN	150kHz to 30MHz Amplitude	3.2dB*
Conducted Emissions, ISN	150kHz to 30MHz Amplitude	2.1dB
Substitution Antenna, Radiated Field	30MHz to 18GHz Amplitude	2.6dB
Discontinuous Interference	150kHz to 30MHz Amplitude	3.0dB*
Interference Power	30MHz to 300MHz Amplitude	3.0dB*
Radiated E-Field Susceptibility	10MHz to 6GHz Test Amplitude	2.0dB†
Conducted Susceptibility RF	50kHz to 1000MHz Amplitude	3.1dB•
	EM Clamp Method of Test	1.2dB•
	CDN Method of Test	1.1dB•
	BCI Clamp Method of Test	1.2dB•
Conducted Susceptibility LF	DC to 150kHz	1.0%†
Power Frequency Magnetic Field	50Hz/60Hz Amplitude	0.45%
Magnetic Emissions	9kHz to 30MHz Amplitude	3.4dB*
Magnetic Field/Flux iaw EN 50366	10Hz to 400kHz	2.64%
Harmonics and Flicker	The test was applied using proprietary equipment that meets the requirements of EN 61000-3-2 and EN 61000-3-3	—
Mains Voltage Variations and Interrupts	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-11	—
Fast Transient Burst	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-4	—
Electrostatic Discharge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-2	—
Surge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-5	—
Vehicle Transients	The test was applied using proprietary equipment that meets the requirements of ISO 7637-1 and 2	—
Compass Safe Distance	Azimuth Accuracy	0.10°
Channel Occupancy/Separation	19.1kHz	N/A
Maximum Output Power	Not Applicable	±0.5dB
Number of Channels	Not Applicable	N/A
20dB Bandwidth	19.1kHz	±0.5dB

Worst case error for both Time and Frequency measurement 12 parts in 10<sup>6</sup>.

- \* In accordance with CISPR 16-4-2
- † In accordance with UKAS Lab 34
- In accordance with EN61000-4-6



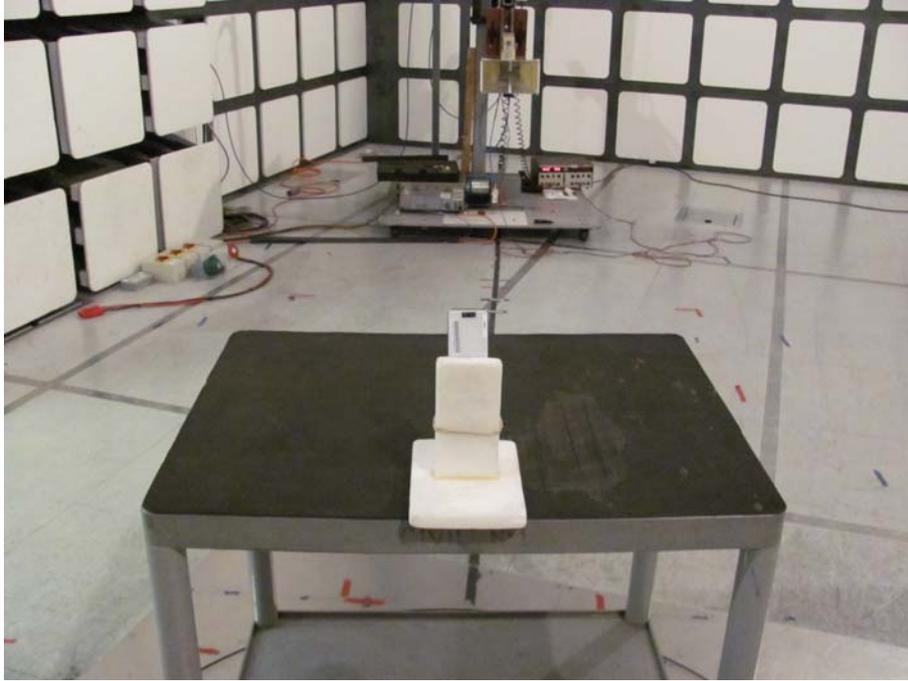
Product Service

## **SECTION 4**

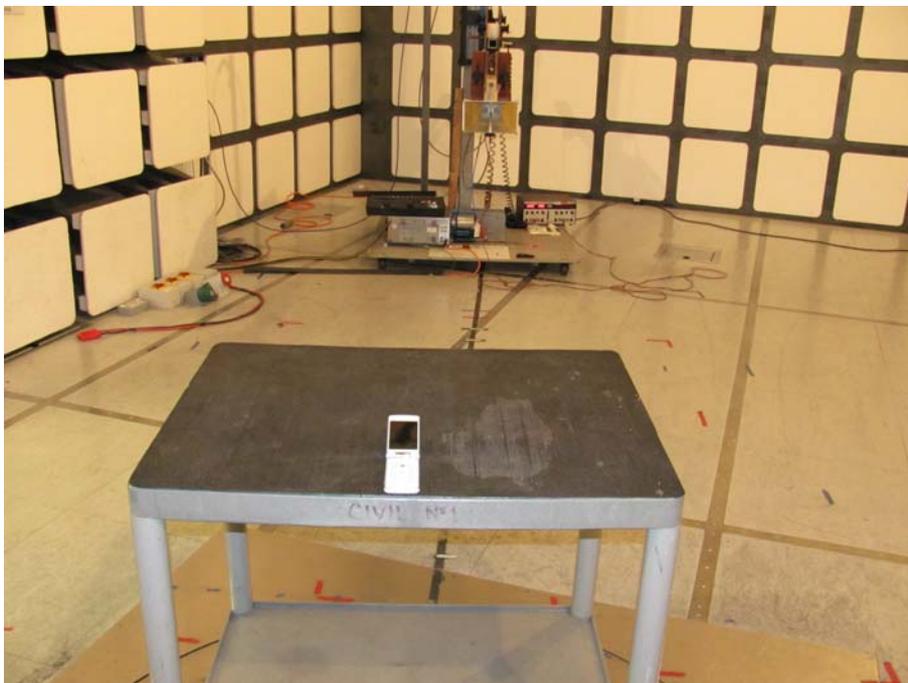
### **PHOTOGRAPHS**



4.1 TEST SET-UP PHOTOGRAPHS



Radiated Emissions –View 1



Radiated Emissions –View 2



Product Service

## **SECTION 5**

### **ACCREDITATION, DISCLAIMERS AND COPYRIGHT**



Product Service

## 5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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